ENGINEERING NEWS

THE DYNAMITE GUN TESTS, made with the 15-in. gun on Jan. 19 and 26, are pronounced satisfactory by the Secretary of the Navy. The official report submitted last week by the Naval Board is very full. The substance is that with a target of 50 x 150 ft., marked on the surface of the water by buoys, and with a range of 300, 1,700, and 2,100 yds., more than one-half of the shots fell within the target in each case. A projectile carrying 500 lbs. of high explosive was thrown 16 yds. short of one mile, and a 220-lbs. projectile was thrown 1¾ miles.

ELECTRIC STREET CAR PROPULSION, under the Julien system, is stated by the company to stand as follows:

On the Fourth Ave. line its cars are now running three round trips, or 36 miles, without change of battery; and it is expected that four trips, or 48 miles, can be accomplished without change, as, at the end of the third trip, the voltage of the battery is still above 2 volts per cell. When the battery is fully charged, the voltage stands at about 320 (144 cells). Twelve miles are run on an expenditure of less than 15 E. H. P. Calculating the cost to be 2 cts. per H. P. hour, it costs 30 cts. for energy for a round trip of 12 miles, or 2½ cts. per mile, exclusive of wear and tear.

The company expects better results with the cars now building, as they will be furnished with a far more efficient motor than those now in use, and the weight of the new cars will be at least 2 tons lighter than those running.

THE COAST-DEFENSE ARMORCLAD, authorized two years ago, with $2,000,000 set aside for her construction, will be let in a few weeks. This vessel is to be of the monitor type modernized. She will be 250 ft. long, have a beam of 59 ft. and a depth of 11½ ft. with a displacement of 4,000 tons. The steel armor will be 16 ins. thick and her engines are to develop 5,400 I. H. P. The armament will consist of one 16-in. breech-loading rifle of 107 tons, capable of throwing a 2,000-lb. projectile with 1,000 lbs. of powder, a projectile which will pierce 36 ins. of wrought-iron. She will also carry a 12-in. rifle with a 1,350-lb. projectile and a powder charge of 675 lbs. This gun will have a muzzle penetration of 32 ins. of wrought-iron.

THE BURNING TUNNEL on the Cincinnati Southern R. R., near Sunbright, Tenn., was extinguished Feb. 21. It was caused by a freight train collision in which 2,800 galls. of oil were set on fire and this fire communicated to the woodwork and to two 12-in. coal seams overlying the tunnel. The work of putting in a brick lining will begin at once.

THE FIFTH AVENUE ELEVATED ROAD, in Brooklyn, is to be put under construction at once, says Asst. Manager HEDDEN. Mr. J. C. JEWETT, the largest property-holder on the line, has had $1.00 damages awarded to him by the Commission to appraise damages. Mr. JEWETT may object, however, and matters be further delayed.

A SUBMERGED TORPEDO BOAT is practically contracted for by the Government with the Columbian Iron Works, of Baltimore. Its motive power is steam generated by petroleum fuel. A Zalinski dynamite gun will be available for surface use, and she is designed to sink beneath the surface on near approach to an enemy and fire torpedoes under the hull. It is claimed that this boat can sink 150 ft. and return to the surface in three minutes.

THE JOHNS HOPKINS UNIVERSITY, which has been financially much crippled by the passing of the B. & O. R. R. dividends, has a surplus fund, and an emergency fund of $100,000 nearly raised, that will enable it to continue for three years without contracting, borrowing, or begging. So said President GILMAN at the anniversary meeting of Feb. 22.

THE QUINDARO BRIDGE is to be built at once over the Missouri river in the interest of the Chicago, Kansas City & Omaha R. R. Co. The enabling bill has passed Congress. The plan calls for an iron and steel bridge 53 ft. above high-water, with three main spans, or two of 400 ft. and one of 450 ft. The approaches will contain 1,800 ft. of iron viaduct and 4,800 ft. of timber trestle. The estimated cost is $850,000. The bill yet awaits the signature of the President.

THE DEATH OF JAS. C. FLOOD, the second of the Big Bonanza four, recalls one of the most remarkable instances of good fortune in the history of mining; remarkable not alone for the enormous sums raised, but for the fact that four different men, all of them of humble, not to say common origin, two of them saloon-keepers and two of them prospectors, should all of them have been able to handle such enormous wealth without losing their heads, and all of them in a fairly useful and creditable way. They bought in the great bonanza property, after it had been considerably worked, for $70,000, all told, and made legitimately and by stock speculations about $20,000,000 each, $44,000,000 in all having been declared in dividends, and about $112,000,000 actually produced from the mine.

SAN DIEGO'S GREAT FLUME was completed last week. It is 50 miles long, with a reservoir at an elevation of 4,500 ft. on the western slope of the Cuyamaca mountain, and cost $900,000. There are on the line 350 trestle bridges and 8 tunnels, and 900,000,000 ft. B. M. of lumber were consumed in construction. Irrigation and water-supply are the purposes of the flume.

THE UNBOUND VOLUMES of the history of the St. Louis Bridge, by Prof. C. M. WOODWARD, were recently destroyed by fire, all but 24 copies. Their price has accordingly been raised 25 per cent., to $15 per copy, which is still well below the original price of publication, as it is a very valuable and complete work. There are, however, a few copies but slightly injured by fire which will be bound and sold at a still further reduced rate, depending on condition. All the remaining copies will doubtless soon be sold, so this notice may be considered as the last chance for would-be purchasers.

THE MANCHESTER CANAL WORKS now employ 10,000 men. Of the eight sections into which the work is divided, most progress has probably been made on the 4 miles between Eastham and Ellesmere Port. Here 1,300 men have taken out, since about Jan. 1, 1,160,000 cu. yds. of earth. On the 4 miles from Ellesmere Port to Ince, about 1,000,000 cu. yds. had been removed by Jan. 1, including 30,000 cu. yds. of rock. Work on other sections is progressing with equal rapidity. It may be said that work was commenced about 15 months ago, and the finished canal will be 35 miles long, 26 ft. deep, and have a bottom minimum width of 120 ft.

RAPID TRANSIT IN BOSTON, on the Berlin system, is recommended in a late paper by Mr. HENRY MANLEY read before the Boston Society of Civil Engineers. The paper advocates a combination of surface roads and elevated tracks over private property. Narrow and crowded streets make the New York plan inadmissible, and the low ground and difficult drainage make the London plan quite as impracticable.

THE CHAPIN MINE, in the Lake Superior iron region, is reported as sold to German parties for $2,000,000 cash, including its vessel interest and hydraulic power plant on the Menominee river. According to the Marquette *Mining Journal*, the ore vein is 4,000 × 120 ft., and has an estimated contents of 40,000,000 tons of ore. Between 1880 and 1889 it has put on the market 1,938,117 gross tons of ore. In 1887 alone it produced 336,123 tons. Dr. CHAPIN, of Niles, Mich., the original owner, has received a royalty of 50 cts. per ton since 1880.

AN ELECTRIC MOTOR FOR A BRIDGE DRAW has been introduced at Bridgeport, Conn. The motor is 7½ horse-power, and the power is transmitted from the electric light station half a mile away. The 1,600 revolutions per minute of the motor are reduced by gearing to 9 revolutions per minute and the operation is said to be steady and sure.

THE GUARANTEED RAILWAYS OF INDIA are sadly in need of fixed standards, according to a late article in the *Indian Engineer*. The pot-sleeper, for example, is the standard on the Madras Railway and the lines of the Great Indian Peninsula Railway Company: yet 20 years ago this same sleeper was found unsuited for high speeds and heavy loads by the East Indian Railway Company, and has been replaced by other types, or used on sidings since. Other lines prefer a bowl-sleeper of corrugated steel, and others still a trough-shaped steel sleeper of a section claimed by experts to be too light for use in India. The same lack of uniformity holds good with fish-plates, bolts, chairs, and all manner of railway furniture. The gauges are notoriously different, and the late call for fitting all railways with automatic brakes is met by the impossibility of so doing without altering all rolling-stock to some standard type.

A TUNNEL EIGHT MILES LONG, through gneiss rock, is proposed to bring the waters of Oegeren-See to Christiana, Norway. According to *La Semaine des Constructeurs*, the tunnel will have a circular section nearly 16 ft. in diameter and will run half full. The surface of the lake is 330 ft. above the sea level, and its shores are surrounded by forests whose timber will be floated through the tunnel to the seaport. The water power thus rendered available is estimated at 24,000 H. P.

A 1,000 MILE SUBMARINE CABLE is to be laid from Banjoewangie to Western Australia, to avoid interruption from volcanic upheaval, etc. Another cable, 700 miles long, is being made to connect Loando with Mossamedes, on the west coast of Africa.

THE COVERED RESERVOIRS OF CARTHAGE, dating back fully 2,000 years, are being restored by the Gas and Water Co. of Tunis. These reservoirs cover a space of 420 by 89½ ft., and are divided into 18 communicating compartments. They have been used several times before in widely separated periods. They were in full working order in the time of Hannibal, were again repaired under the Emperor HADRIAN, and have been entirely neglected since the eruption of the Arabs, in A. D. 697, until the present French company took them in hand again. From the description given in *Le Genie Civil*, it would appear that the French engineers are practically reviving the plans of the original Carthaginian engineers; a remarkable instance of the ebb and flow of civilization in this ancient corner of our historical world.

THE WORST ACCIDENT OF THE WEEK and of the year so far, is reported as we go to press, on the Grand Trunk Railway, at St. George, Ont., Feb. 27; a bridge disaster, due apparently to the vicious system of half-open, unprotected bridge floors which are so common. The bridge at this point was formerly a wooden structure, but has lately been replaced with an iron bridge on stone piers, apparently of three spans. The train consisted of engine, tender, baggage car (which passed over in safety) passenger coach (which stripped the ties off, piled them up together, and then fell over into the river) Pullman and dining car. The names of 9 dead and 30 injured are reported and there are probably still more. The cause appears to have been a broken piston rod. The facts are somewhat obscure, but it appears clear that nothing serious would have happened except for the defects of the bridge floor.

THE NEXT MOST SERIOUS ACCIDENT was the wreck of a passenger train on the Maine Central near Boyd's station, Me., on Feb. 23. The train was an express from Bangor, Me., to St. John, N. B., and consisted of an engine, mail car, baggage car, Pullman car and four passenger cars. A switch leading to a side-track was open, and as the side-track left the main track with a sharp curve, the engine left the rails and the mail and baggage cars were piled upon it. The train was heated by steam but there was a stove in the mail car and it quickly set fire to the wreck and four cars were burned. Two men were burned to death. The accident is said to have been caused by the carelessness of the crew of a freight train which had been switching cars on the side-track, and they had omitted to close the switch when this work was finished. The absurdity of making every car but one safe, and leaving that in condition to readily set fire to all the others, was well illustrated by this accident.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On Feb. 21, the floor of a bridge at Cowansville, Ont., gave way while being repaired and several men were injured.——At Newton, S. C., a railway trestle was damaged by flood.

THE SUFFERING FROM THE YELLOW RIVER INUNDATION in China is reported to be very great, and an appeal to the world for relief has been issued. Over a million persons are reported to be actually starving. The problem of closing the break is a great one. The gap in its banks, through which the river has broken, is 400 ft. wide, and the water is pouring through at the rate of nearly 10 miles an hour in a stream 100 ft. deep. The flow is nearly at right angles to its former course. A bank 40 ft. to 50 ft. wide is being run along the banks of the stream constructed of interposed layers of stalks and sand. Thousands of brick are also being manufactured for the work. It is curious to note that the old bed of the river is 20 ft. above the surrounding country, and is now the only part secure from inundation.

TACOMA REAL ESTATE is to be boomed, if we can believe the report of purchases by the officials of the Northern Pacific Railroad. Mr. VILLARD is said to have invested $286,000 lately for himself and friends, and Mr. PRESCOTT, First Vice President, is supposed to have bought, since Jan. 1, $16,000 of real estate. The Terminal Company, recently formed, is expected "to spend over $2,000,000 in betterments at the Tacoma terminal."

THE NEWARK, N. J., WATER SUPPLY QUESTION is yet undecided. The Lehigh Valley R. R. proposition is complete in its details, but a public meeting is to be first held, to enable interested citizens to present their views. The essential features of the revised proposal of the railway company are as follows: A water company is to be properly organized, with $3,000,000 capital, and the Lehigh Valley R. R. Co. will place at its disposal all the necessary water. The water company is to contract to supply to Newark, for its own exclusive use, water from either the Pequannock, Ramapo, or Wynockie water-sheds for 25 years at the rate of $39 per million gallons up to a consumption of 20,000,000 galls. daily; this sum is to be reduced at the rate of 50 cts. for every million gallons above the first-named amount until the price will be $36 per million gallons, and it is to remain at that price thereafter. Water is to be delivered in 15 months from date of contract. Within two years the city may terminate the above arrangement by exercising either of the following options: For $4,000,000 cash, or 30-year city bonds at 4 per cent., it may acquire a supply not exceeding 25,000,000 galls. daily, with reservoirs of a capacity equal to a supply of 27,500,000 galls. daily and a conduit of best material, not more expensive than steel, equal to the delivery of a 4-ft. pipe. And in this case the company will guarantee these several quantities and works for 5 years. The second option is that for $6,000,000 it may acquire a supply not exceeding 50,000,000 galls. daily, with reservoirs and conduits adapted to this supply. The water is to be delivered by gravity alone, with a high-service pressure greater than the existing one.

THE CABLE STEAMER *Faraday* completed on Feb. 18 the laying of 826 miles of heavy submarine cable between Coatzacoalcos, Mexico, and Galveston, Tex., for the Mexican Telegraph Company, thus duplicating its Gulf system of cables and insuring more speedy telegraphic communication with Mexican, Central, and South America.

SUNDAY TRAINS are to be taken off all the lines of the Pennsylvania system so far as possible. The order to cease running freight trains on Sunday, except such as carry perishable freight or live-stock, has been extended to cover all the Pennsylvania lines west of Pittsburg and Erie. It is stated that the managers of the Santa Fé system are considering a similar move. Just now, when reduction of expenses is the watchword everywhere, it would seem a very favorable time to inaugurate this reform.

THE FORTH BRIDGE CONTRACT CASE, between Messrs. Tancreed, Arrol & Co. and the Steel Company of Scotland, has been finally decided against the first named party, excepting expenses of proof. The charge was that the bridge contractors had failed to carry out the terms of a contract in which the Steel Co. was to furnish "the whole steel required for the Forth Bridge," less 12,000 tons of plates. This case has been in litigation for some time, and has finally been adjusted on a basis of 5,000 tons of steel and the difference between contract and current-market rates, which would amount to about $74,250.

THE INSPECTOR OF STATION AND TRAIN SERVICE is a new officer created by a late circular of the Wabash R. R. The duties of this official, who is not clothed with authority in matters of discipline, are, to go among the agents, operators, and trainmen on the road, to question each man or crew about the rules, and to observe how they are carried out, to answer all questions propounded regarding the proper construction of each rule, and in every way to aid the men to become more efficient employés, and the management to render the public first-class service.

THE BRAZOS RIVER IMPROVEMENT promises success, according to a recent interview with Mr. E. L. CORTHELL, who is the engineer of the work which is to make a harbor at the mouth of this river by jetties. He found that during the late high water, the former 6 to 12-ft. channel had been deepened to 17 ft. for 9,000 ft. from the line, showing that properly constructed training works will speedily make a navigable channel between the river and the gulf.

The San Mateo Dam.

We have been expecting for some time to publish full details of the great San Mateo dam, which has now been in progress nearly two years, and is expected to reach completion next August. By the courtesy of Mr JAS. D. SCHUYLER, we are enabled to present the accompanying views of the work, and we are likewise indebted to him for the following notes of the present status of the works, as observed in a visit last fall. The dam was briefly referred to in the reports of Messrs. CHURCH and FTELEY to the Croton Aqueduct Commission (published in this journal in January, 1888), where an imperfect and inaccurate plan and profile is given of it. With this exception, there has been no reference, beyond brief mention in engineering journals, to what is without doubt the greatest engineering work of its class now in progress in the United States.

As our readers may remember, the dam is being made of concrete, is to be 170 ft. in height, 180 ft. thick at the base, with a 25-ft. roadway on top. Its length on top is about 700 ft., at base about 200 ft. It is being constructed in arch form, with a radius of 835 ft. When completed it will form a reservoir with a capacity of about 31,000 million galls. Its estimated cost is $2,000,000. It is to be a part of the storage system of the Spring Valley Water-Works supplying San Francisco. The work is wonderfully well organized under the able supervision of HERMAN SCHUSSLER, Chief Engineer, and is being carried out in the most thorough manner. At the time of Mr. SCHUYLER's visit about 1,000 men were employed, and everything moved along like clockwork without accident or jar of any sort. The photographs, from which we have prepared engravings, give a pretty clear idea of the method of work. Fig. 1 shows the three-story concrete mixing platform, with the trestle leading out to the center of the cañon immediately below the foot of the dam. The 6 smokestacks indicate the position of 6 engines, each of which drives a rock crusher, a revolving cylinder for washing the broken rock, and a concrete mixer. The rock is delivered by wagons from the quarry (about 1,000 ft. distant) to the upper platform, which is about level with the top of the dam when completed. At the second platform the cement and sand are delivered in cars, and, in proper proportions, are measured out into the shutes leading to the concrete mixers hanging directly beneath. The crushed rock, after being thoroughly washed, is also delivered in cars upon the second platform, and added to the sand and cement, in the proportion of 6½ bbls. broken stone (of all sizes up to that of a hen's egg), 2 bbls. sand, 1 bbl. cement, and ⅔ bbl. water. From the mixer the concrete is discharged into cars run by hand upon

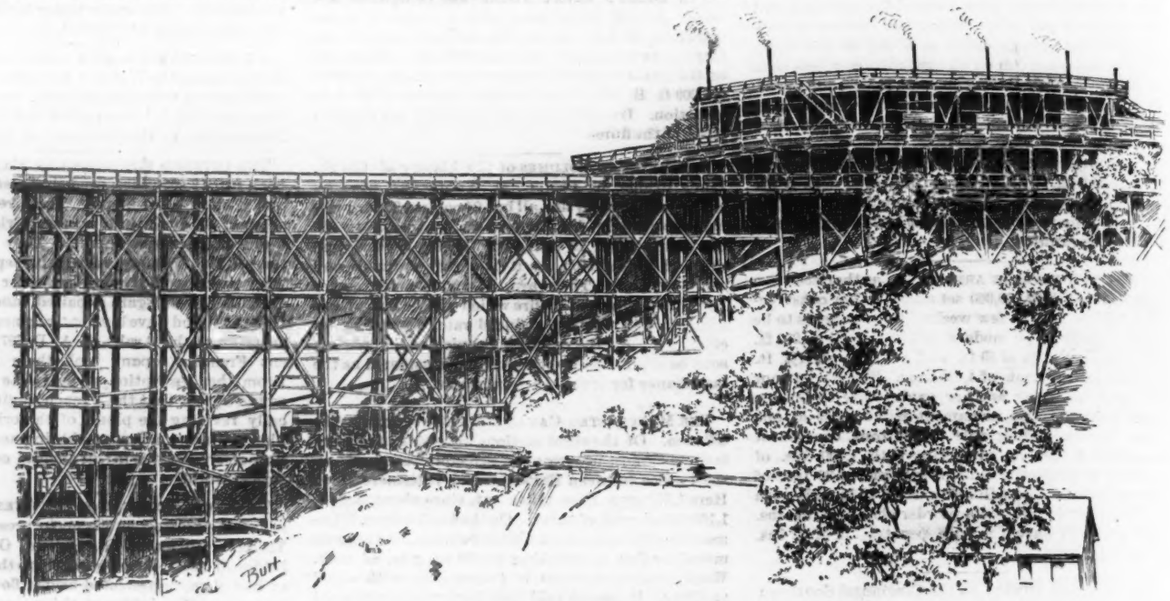


Fig. 1. Concrete Mixing Platform and Trestle.
San Mateo Dam, Spring Valley (San Francisco, Cal.,) Water-Works, HERMANN SCHUSSLER, *Chief Engineer*.

light tracks out on the trestle to the left, where it is dumped into funnels between the rails that open into 16-in. wrought iron pipes, standing vertically. These pipes lead to within about 4 ft. of the platform on to which the concrete drops. Underneath the ends of the pipes are placed heavy steel plates, resting on a floor supported independently of the high trestle, which receives the shock of the weight. From here it is shoveled into wheelbarrows and wheeled on to the dam. At the start, the vertical drop of the concrete was about 120 ft., but the workmen shoveled it up as it came, without fear, and it dropped without much splash.

Fig. 2 gives a view from the upper side of the dam looking southwest, showing the end of the dumping trestle, the vertical pipe-shutes, and the completed portion of the dam, with the frame still in position. The height reached at the time this view was taken was about 90 ft. from the foundation.

Fig. 3 shows the northern buttress, with the partially completed trenches cut into the solid rock: also a top view of the framework with which the blocks are formed, and the wheeling platform leading from the pipe-shutes. In the upper left-hand corner is the staging around the main shaft, and a little lower down is the end of one of the 4 outlet tunnels leading into the shaft.

Fig. 4 shows the bottom and two sides of a chamber in which a new block is to be formed, and illustrates the care taken to break joints and avoid anything like "range-work." The surface has been carefully roughened with picks, thoroughly swept down and scrubbed with brooms. The concrete is spread in thin layers and rammed with iron rammers by an army of workmen that quickly go over the whole surface. About three of these blocks are completed daily, the dimension of each being about 30 ft. × 30 ft. × 10 ft. thick. The rate of progress is about 1,000 cu. yds. a day. A stream of water is sprayed constantly over the completed portion of the work, after it has begun to set, and it is all carefully shaded from the sun by planking laid over each finished section.

The cost of the concrete is about $8.00 per cu. yd. The cement consumed will be about 300,000 bbls., costing in San Francisco $3.00 to $3.25 per bbl. English and German Portland is exclusively used. It is transported by rail to San Mateo, 20 miles, and thence by wagon, 5 miles, to the dam, at a cost of 17 cts. per bbl. One of the chief items of expense is the sand, which is brought from the sand dunes of North Beach, San Francisco, where it is loaded on tram-cars, dumped into barges, towed 20 miles up the bay to San Mateo landing, and hauled by teams 8 miles. Its cost delivered is $2.00 per cu. yd. On account of the muddy condition of the road, work has to be suspended during the rainy season, from about October to April or May.

The outlets to the reservoir are, a main tunnel at bottom, leading from below the dam to the main shaft just above the dam, extending from top to bottom, with four smaller tunnels leading into the main shaft at different levels, 40 ft. apart in elevation. The shaft is 20 ft. in diameter, lined with brick, and carries at one side a huge vertical cast-iron pipe, surrounded with brick, and connected with pipes leading from each of the outlet tunnels, with gates in the main shaft outside the standpipe in each of the outlet pipes. The standpipe connects with the delivery main laid in the main tunnel. One can thus pass dry-shod through the main tunnel and up the shaft, inside the reservoir, alongside the delivery pipes, and the reservoir may be tapped at any one of four levels. At the outer ends of the outlet tunnels are bell-mouths, with brass-lined seats to receive butterfly valves, which may be lowered in place, in case it is necessary to repair any one of the main gates in the shaft.

After the completion of this dam the company will prepare for the construction of a similar dam 230 ft. high, in Calaveras valley, on the opposite side of the bay. They are now using the natural flow of the stream from Calaveras valley by a line of wrought-iron pipe, 30 in. diam., laid this year. This line is about 30 miles in length, and was laid in haste to get the additional 5,000,000 galls. daily which the creek afforded. It necessitated two lines of 16-in. submarine pipe, laid under San Francisco bay, and costly pumping works at Belmont. The detail of the laying of this submarine pipe is extremely interesting and worthy of more elaborate description than it has received. We shall hope to obtain hereafter a fuller account of this work from some of our Pacific Coast correspondents.

We may appropriately close the account of this great work by noting that Mr. SCHUYLER has in contemplation the construction of an even greater dam than either the San Mateo or Calaveras Valley dam referred to herein, on the headwaters of the Kern river, as noted in our issue of Oct. 27, 1888. This dam is to be 250 ft. high, of the rock-fill type, constructed by running drifts into cliffs which form the walls of a deep gorge, filling the drifts with heavy charges of dynamite, and so closing the whole gorge by a single shot.

Its situation, deep in the recesses of the Sierra, makes it impossible to begin work on it before spring. One interesting feature connected with it is that, as it is to store water for irrigation, that is, to fortify a stream already fully used at times of greatest scarcity, one of the requirements will be the emptying of the enormous reservoir, thought to be the largest in the world, in 30 to 90 days. This necessitates the provision of outlets having a maximum capacity of 1,000 cu. ft. per second, at any stage of the water. It will be at once apparent that these requirements are unusual. We do not recall any reservoir having any such discharge capacity. If our readers are cognizant of anything like it, we are sure they will oblige the profession generally, as well as this journal, by sending us the facts regarding it.

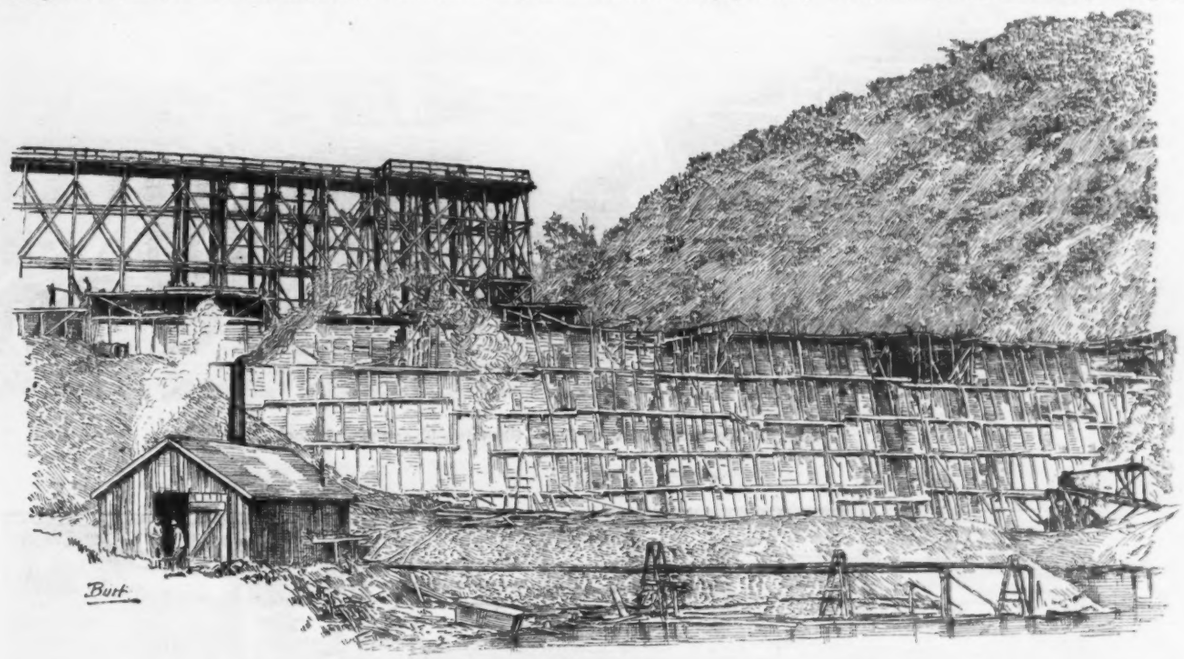


Fig. 2. View of Upper Side of Dam, Showing End of Dumping Trestle.

The Laws Governing the Construction and Maintenance of Country Roads in France.

[Continued from page 160.]

Cash Work.—In theory all work for which money is paid should be executed under a public contract. Nevertheless, with the authority of the prefect, certain work may be let by private agreement under the following conditions:—I. For work or supplies when the value does not exceed $600. II. For work where the conditions forbid the delay of a public letting. III. That which by its nature requires special skill and experience on the part of the contractor. IV. That which cannot be let by contract after two several attempts to do so. Work may also, with the authority of the prefect, be economically carried out, either directly under the control of the inspectors, or by way of indirect taxes, in cases of urgency or when other methods of execution have been recognized as impossible or less advantageous. Under these conditions the work should, if possible, be accomplished by the task system.

All projects must be approved by the prefect, and all specifications for work must contain the clause that the contracts are subject to the general conditions imposed upon contractors for vicinal roads as annexed to the general instructions issued on Dec. 6, 1870.

The provisional or final acceptance of work performed upon main highways of roads common to several communes lies with the inspector of the arrondissement, assisted by the inspector of the canton, and made in the presence of the contractor. The acceptance of vicinal roads lies with the mayor, in the presence of the inspector of the canton, two members of the Municipal Council, and the contractor. The contractor is always summoned on these occasions, but his absence is no obstacle to the action of the officials.

All difficulties arising from disagreement as to

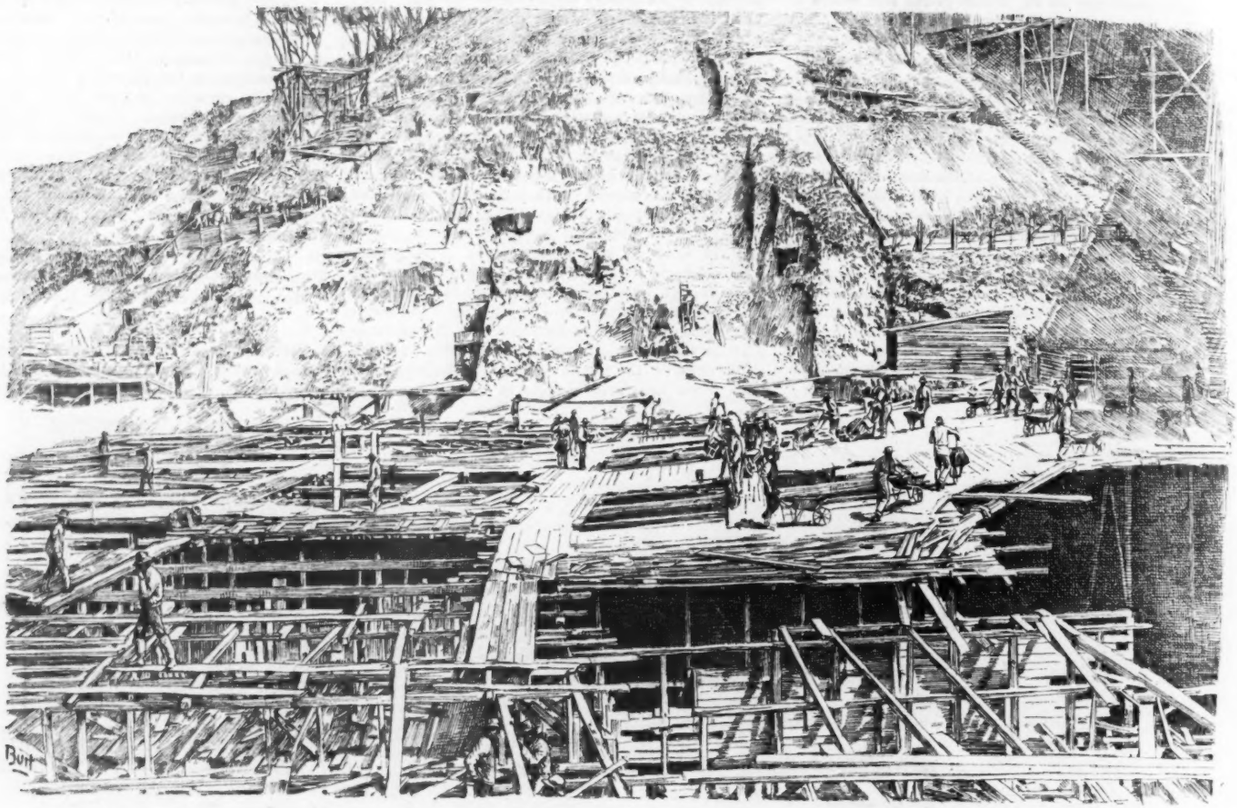


Fig. 3. Northern End of Dam, Showing Trenches in Rock.

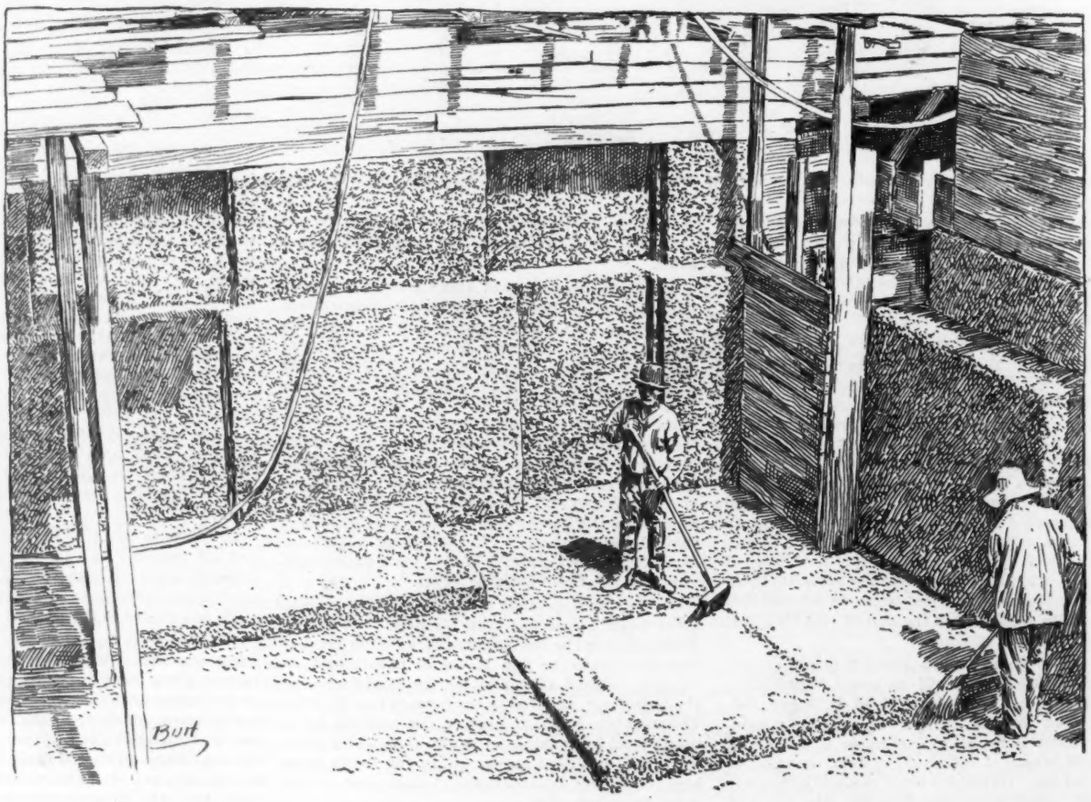


Fig. 4. Chamber for New Concrete Block.

work performed on vicinal roads, or from damage caused by these works, and not arising from a material expropriation of lands, can be adjusted by the Council of the Prefecture, with appeal to the Council of State.

Commissions of Supervision.—In some departments the prefects have thought it proper to delegate a portion of the care of inspection required by the many details of work on vicinal roads to a commission appointed by the prefect and made up from members of the General Council, the councils of the arrondissements, the mayors, and certain proprietors particularly interested in the good condition of the roads. When a road passes through two arrondissements, and is too long to be easily watched by one commission, it may be divided, and its several parts supervised by distinct commissions. Each commission names its own president and secretary, and fixes the day and place of meeting. When the prefect or sub-prefect attends a meeting, he is the president for the time being.

When the prefect thinks best, these commissions may be consulted upon projects recommended by the inspectors for new works, and upon the basis of a division of expenses between the communes. They may also designate several of their number to take part in the acceptance of work done by contract. Within the first three months of the year, these commissions send to the sub-prefects their observations upon the state of the roads, and point out the localities most urgently needing repair. In this report they also name the workmen who have most faithfully performed their duty, as well as those who have been careless or slow in the performance of their work.

The Police of the Roads.—No one without previous authority can perform any act upon a road that in any way interferes with its function as a public way or interrupts travel. And it is especially forbidden to make any trenches or openings, deposit stones, earth, or rubbish upon it; to take away any sand, gravel, or other material; to spread anything over the road; to divert water channels so as to cause washing of the road; to interrupt in any way the flow of water in the ditches, even temporarily; to construct or repair any building, wall, etc., bordering the road; to open ditches, plant trees or hedges along said road, or to dig wells or cisterns nearer to the road than provided in the general regulations. To perform any of these interded acts authority must first be formally requested. For all vicinal roads, this authority is granted by the mayor with the advice of the inspector; and in no case can the mayors give a verba authorization. For main highways and other more important roads the authority comes from the prefect, upon the report of the inspectors, or from the sub-prefect under similar advice. Every authorization expressly reserves the rights of third parties, and stipulates that the roads must be restored to their normal good condition.

Ditches and Slopes.—In giving to the department commissioners or to the Council General the right to give to vicinal roads the necessary width, the law of 1871 accorded them the right to include all the land required for proper ditches and slopes. These ditches must be cleaned as often as necessary, and the expense of so doing is charged to the commune. The ditches, being a legal part of the road, are protected against encroachment in the same manner as the road proper. If the authorities have not opened a ditch along the whole length of a road, as sometimes happens, the bordering proprietors may do so by first having the lines and levels given them by the proper parties; without this authority they are expressly forbidden to touch the ditches. The care of ditches, opened for their own protection and convenience, lies in the hands of the proprietors.

Rural Roads.—Outside of the vicinal roads prop erly so called, there are in all communes a certain number of minor roads or means of communication. While of little importance, perhaps, they must yet be carefully maintained, as they may lead to a public fountain, a watering place for cattle, or to common pasturage. Such roads are termed *chemins ruraux*, or rural roads, in the law of 1839; but they are really public roads in the sense that their use is open to all, that they cannot be claimed as private property by the owners of adjoining soil, and that they are legally under the care of the public authorities and are maintained in the same manner as are other roads of the commune.

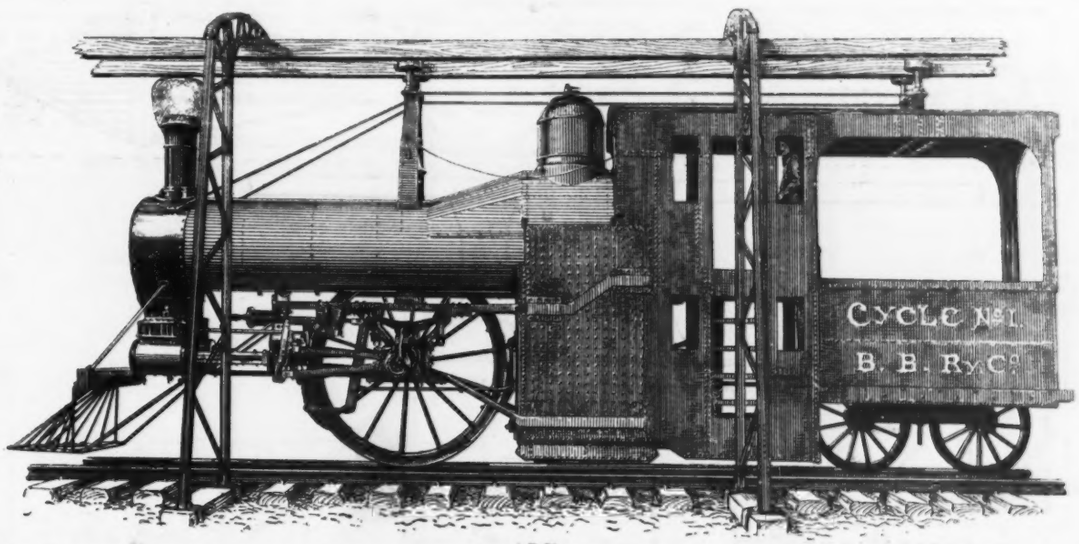
The method adopted is to carefully map every road and even public path in the commune, and expose this plan for one month at the office of the mayor of the commune. Any objections made to the correctness of the plot or claims of private ownership of roads shown are submitted to the municipal counsel, who is to sift out those having a basis of fact. And this same official renders an opinion upon the degree of utility of each of the roads shown, and the possibility of suppressing certain ones so that the soil may be sold for the benefit of the commune. The map with the report of the municipal counsel is then submitted to the prefect of the department, who examines it to see that no vicinal roads have been included under the head of "rural." The opposition to the official dedication of a certain road may be founded upon a claim of property, or upon the fact that it is not public. The property claim is regularly decided in the courts of justice; the second case must be decided by the administrative power, that is the prefect.

When a minor road of this kind is definitely classified as a "rural road," it is public property, and the administrative authority itself cannot restrain circulation except in case of absolute necessity. If a commune wishes to enlarge such a road, it can do so only by an amicable agreement with the owner of the necessary land, unless the prefect officially classes it among vicinal roads. If a rural road is suppressed, the soil can be sold for the benefit of the commune; but, in such case, the proprietors bordering on such a road can either demand that the use of it be continued to them, or that the commune provide some other passage, or pay them an indemnity.

(TO BE CONTINUED.)

The Boynton Bicycle Railway.

We present herewith a photograph and detail drawings of an exceedingly novel type of railway, with the locomotives and cars which are to run upon it. Whatever opinion the reader may form as to its merits, it is certainly an interesting and ingenious novelty, having in favor of its general idea some possibilities not unworthy of serious consid-



The Boynton Bicycle Locomotive. From a Photograph of a 22-ton Engine, Built by the Portland Locomotive Works, Portland, Me.

eration, which are, and which may yet prove to be facts worth knowing, as pointed out below. In any case, the experiment must continue to be watched with interest to see what comes of it. The cardinal ideas of the inventor and his claims for his device are as follows; we quote them in the inventor's own words, but must not be understood to assume any responsibility as to details by quoting them some of the claims seeming rather broad:

The 25-lb. Bicycle will carry ten times its weight. Railroads now require one hundred times this weight, or over one ton of train, to convey each passenger and drag one-half the entire train weight around the curves on the iron on fixed wheels. The principle of the Bicycle, saving in weight and friction a hundredfold, is here extended and applied to the present steam railroads.

A calm perusal will demonstrate that trains, narrow, deep, and strong, of one-fifth the weight, may be guided on the present railroad tracks by an overhanging structure, supporting dependent guide rails, about 16 ft. above the present railroad tracks, of standard gauge (4 ft. 8½ ins). This will permit grooved guiding wheels of single-rail trains to engage and glide under a single overhead rail, against which the wheels are held by a vertical spindle shaft and spiral springs, projected upwards from steel cars, 48 ins. wide, 14 ft. (or more) deep, supported by and riding upon a single rail below on precisely similar double-flanged supporting wheels

[Since the above was written, Mr. BOYNTON has altered the design of his overhead structure, and now uses, as shown in the engravings, a single overhead rail of wood, on either side of which are placed two small horizontal guide wheels.— ED.]

By this system, not only fivefold saving over the weight of cars of equal capacity for freight and passengers of the present system, but a further saving of fivefold power required in rounding curves is effected by the substitution of single-rail Bicycle spindle wheels instead of the double-axle wheels of the two-railed tracks now in use. This saving, fivefold in weight, multiplied by the saving of fivefold in friction, gives

the bicycle system an advantage so great as to render competition by present railroad or even water transportation impracticable.

The Erie Railroad 6-ft. gauge, narrowed to 4 ft., 8½ ins. gauge, saves nearly one-half weight, strain, and friction, or as 36 to 19. The Bicycle vertical spindle wheel reduces this to one, and saves all grinding and wedging in rounding curves. The overhead guiding rail is set inward on curves, tipping the train toward the center of the curve and balancing all centrifugal force upon the lower rail like a bicycle.

About one ton of train weight is now required to convey passengers; and the average freight train, empty, weighs more than the paying freight carried by it, while the Bicycle train carries more than five times its own weight without fivefold loss of wasteful friction. A saving of at least tenfold is thus effected by freight, twenty-fold on passenger cars.

A threefold speed over the present system may readily be attained by substituting the Bicycle trains.

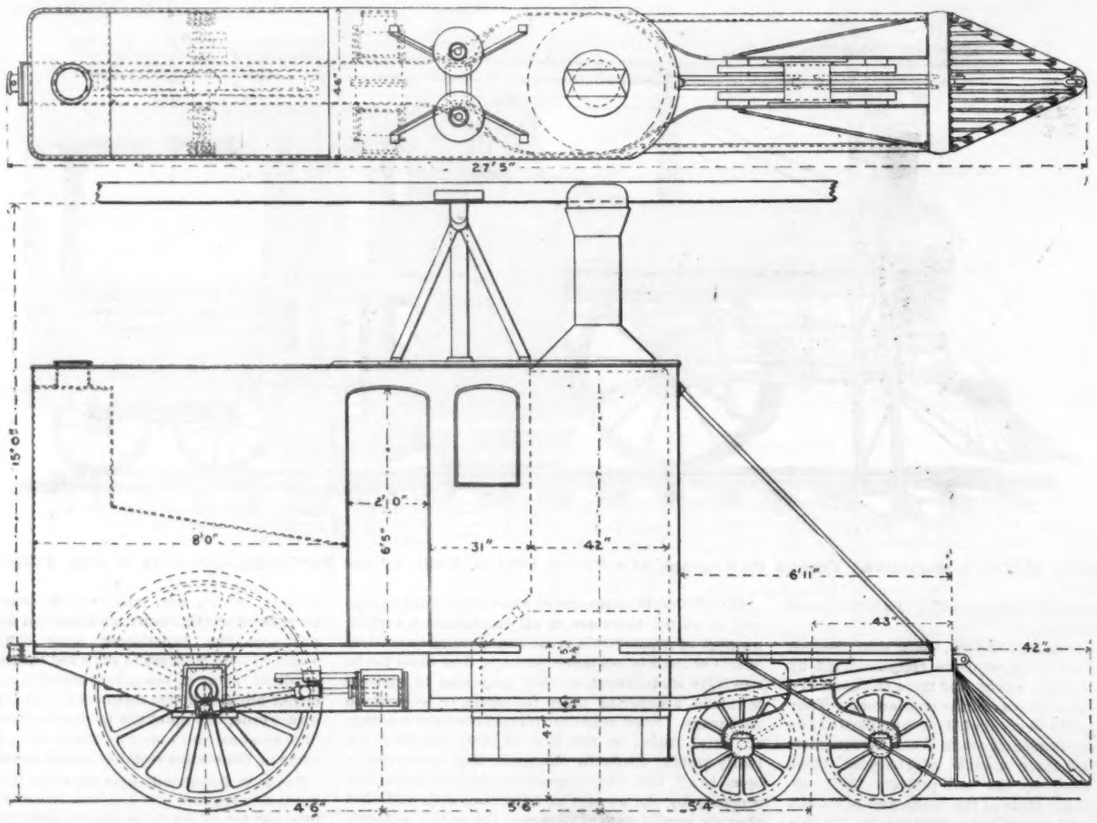
The present standard, 4 ft. 8½ ins. track, can be utilized without change or interference, while building the overhead guiding structure for this new system; its supports, either piles or framed posts, of wood or metal, will be placed outside of the lines of the trains; the overhead guiding rails are supported by cross-ties above the reach of ordinary trains, and permit the passage of two deep Bicycle trains, 46 ins. wide, to run in opposite directions, with one foot clear space between them, while the same track can be used for the ordinary trains jointly until the new economical system has displaced the old.

The largest single investment in the United States except real estate is in railways—exceeding eight billions of dollars, according to Poor's "Railroad Manual" of 1886. Injury to the value of this property is not expected or desired.

This great saving is effected, as shown, without drawing a railway spike or changing the road-bed, and the substitution which causes a saving, many fold while rapid, will not be disastrous. A saving of half the present expense of railroad operation would treble the net income.

Any desirable speed may be attained by increasing the size of driving wheels or shortening the stroke. The Bicycle has hitherto been a marvellous machine, driven by human muscle alone. The highest speed recorded is a man driving himself and machine a mile in 2½ minutes, or at the rate of 24 miles an hour, equalling average railroad speed. If treading a 5-ft. wheel by a man, unaided, gives a single wheel such speed, the stroke of the rapid engine piston would be more than fourfold in speed and a thousandfold in power. And a driving wheel of 10 ft. in diameter could run 200 miles an hour, with its speed limited only by friction and pressure of air. The engine power applied to this narrow, light train permits the maximum speed to be attained with perfect safety for passenger trains, since no derailment is possible. Freight trains would run slower, with corresponding economy. Not only are there retaining wheels against the overhead guide, but the steel crest of the cars likewise embraces the rail, so that if a wheel should break, the train could not leave the track.

Unlike the great majority of inventors, Mr. BOYNTON has been successful in securing funds to carry out and develop his ideas and put his novel transportation system into practical operation. The Boynton Bicycle Railway Company was chartered in January, 1888, and is now making contracts for the application of their system of transportation to at least one existing railway. A company has also been organized to build equipment for these roads, and Messrs. EDWARD R. DAVIES and GEO. F. MORSE, of the Portland Locomotive Works, have joined Mr. BOYNTON in its formation. The first locomotive for the company was finished at the Portland works a few weeks ago, and was run on an experimental track at the works for several hours on Feb. 2. The perspective view is from a photograph of this engine, taken on that day. A second and much lighter engine of quite different type, with vertical boiler and truck in front instead of behind, is now approaching completion in the shops of the Portland Company, and is shown in elevation and plan in our engravings. The principal dimensions of each of these locomotives are given in the following table.



The Boynton Bicycle Locomotive. Plan and Elevation of 8-ton Engine, now under Construction at the Portland Locomotive Works.

PRINCIPAL DIMENSIONS OF LOCOMOTIVES.	8-ton engine.	22-ton engine.
Total length	27 ft. 5 ins.	41 ft.
Extreme width	4 ft. 6 ins.	4 ft. 6 ins.
Height, rail to top of smoke stack	15 ft. 6 ins.	15 ft. 6 ins.
Weight, in running order	8 tons	22 tons
Weight on driving wheel	5 tons	14 tons
Wheel base	17 ft. 2 ins.	30 ft. 4 ins.
Driving wheel	5 ft. 6 ins.	8 ft.
Truck wheel	33 ins.	48 ins.
Cylinders	7 × 12 ins.	12 × 14 ins.
Boiler	42 ins.	42 ins.
Diameter upper guide wheels	18¼ ins.	12 ins.
Face of " " "	4 ins.	4 ins.

As regards the details of these locomotives, one of the first things which strikes an engineer is the exceedingly heavy load which has been placed upon the driving wheel of the larger engine. If the engine weighs 22 tons, as we are informed, with 14 tons concentrated upon this single wheel, the load is likely to aggravate the injurious effect which much smaller wheel loads are supposed to have upon the present rail, as discussed in Mr. WHITTEMORE'S paper published in the last three issues of ENGINEERING NEWS. It is only fair to say, however, that this is merely a fault of mechanical detail, easily remedied, and having nothing to do with the merit or demerit of the especial ideas on which the inventor's claims are based.

The passenger car shown has two stories, and it seems quite evident from the engraving that the claim of Mr. BOYNTON to a great saving in dead weight per passenger carried will be realized. Whether this will be attained and an equal degree of comfort secured to the passengers, will depend largely on the arrangement of the car furniture. It may be possible to effect it, notwithstanding the fact that the inside width of the car is only 48 ins. The width of car also is something easily varied. Several cars have been designed for the carriage of special classes of freight, as for grain, coal, ore, etc., which are to be loaded through the roof, and have a wedge-shaped bottom with trap doors, so that the processes of loading and unloading are automatic

But, laying aside all matters of detail, let us consider the cardinal features of the system. Undoubtedly there is a good deal of truth in Mr. BOYNTON'S claim that the present type of railway has great friction from lateral motion; and, as is well known the oscillation which occurs at high speeds is one important element which must be provided for and counteracted before our present type of rolling-stock can be run safely at greatly increased speed. The friction from curves, which the single-rail locomotive largely obviates, is another positive and considerable saving. At first thought, it would seem that there must be a good deal of friction from the horizontal wheels which embrace the overhead rail; but the inventor states that the locomotive is so perfectly balanced that when running on a tangent these wheels seldom touch the overhead rail—a half-inch space is left between them—and that even on curves, as the train is made to lean in-

wards to balance the centrifugal force, the friction of the overhead wheels will be but trifling.

How much truth or probability is there in the inventor's claim? Here we touch upon a question which, before the invention of the bicycle, would have been likely to be answered by all engineers, immediately and positively, by "None at all." The bicycle and its strange mechanical properties, to our thinking, put a very different face on it, and, aided by such light as can be had from modern bicycle experience, almost every one of our readers can go back to his boyish days when he rolled a hoop, and see further reason for suspending judgment, recalling the effect of that mechanical paradox by which the laws of gravity appear to be suspended when a hoop is rolling forward, so that, if only it be rolled fast enough, it not only does not tend to fall over, but can hardly be made to fall over by a lateral blow.

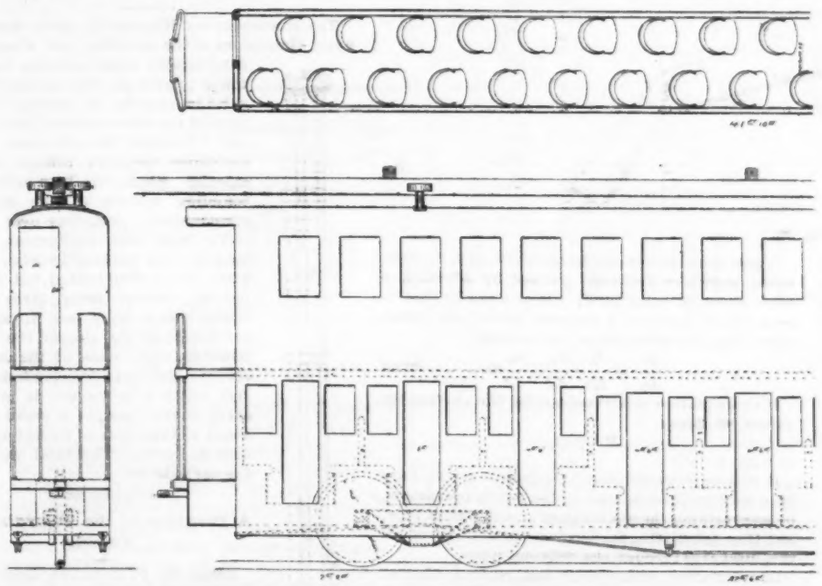
The bicycle as a modern invention dates only from 1869, and in its more perfect modern form, from ten years later. In 1815 a few bicycles were made to be propelled by the feet touching the ground on each side; but the finest modern bicycle, with 60-in. wheels, only weighs from 20 to 35 lbs., and it not only permits of great speed, but is very easy to ride, so that falls rarely or never occur after the art of riding has been once mastered. As for friction, 100 miles has been made in less than 8 hours by a man of ordinary strength, showing how slight must be the frictional loss, for a man's strength to carry him so far in so short a time.

Is there any reason in the nature of things why this bicycle principle of motion cannot be utilized for maintaining the equilibrium of trains, so ensuring a vertical position without relying upon a double rail or (to any extent except as a safeguard) upon an overhead guide? We fail to see it; nor do we see why the overhead guide, although of course an absolute necessity for safety and for passing curves, should not be almost unstrained at the highest speeds, especially if a certain considerable play be left between the guide rail and the wheels. At stations and stopping places no such play would be desirable, but it could be eliminated there by thickening the rail at stations.

That the motion of a train running on a single rail in this manner might be very much smoother and safer, seems to us reasonable, or at least a chance worth thorough investigation. It is a wholly different matter from narrowing the gauge. So long as the reliance for stability is on the support of a pair of rails (the center of gravity falling between them), all narrowing of gauge must be a disadvantage; and, as it is impossible to maintain a pair of rails exactly horizontal, there must inevitably be a jerking of the train from side to side which at high speeds becomes exceedingly dangerous; because, whenever the level is not perfect, there is a tendency created to lateral impact against one rail or the other. In bicycle motion all this tendency is eliminated. There is nothing but the forward motion to maintain perpendicularity in the vehicles (except when the top guard-rail comes by accident into action), nor is anything more needed. Hence there is only the vertical irregularities of the rail to be taken into account; and even if they should cause considerable bouncing at points, it is directly up and down, without tendency to cause lateral motion, the center of gravity being directly over the point of support and tending, unaided, to stay there. Taking into account this great potential advantage and the smaller cross-section of the train, it appears reasonable that a much higher rate of speed may be safely maintained than is either possible or safe with double-rail vehicles.

The cost of construction of new roads also should be much reduced if the principle be feasible. The passage of curves, if we may trust the analogy with bicycle action, should be likewise smooth and easy.

To now enter into further details would seem altogether inexpedient, but we see no reason to doubt that very high speeds can be attained on the single track railway; and if this can be done with reasonable safety, economy, and comfort, as seems likewise probable, the bicycle train will certainly not want for pasengers. We are informed by Mr. BOYNTON that the company has already made contracts for two lines of railway which are to be put into operation on this system before June next. One of these is to run between New York and Coney Island. We shall watch the further progress of the experiment with great interest, and are strongly disposed to believe that if Mr. BOYNTON has not or does not solve the problem, some one else will.



Passenger Car for the Boynton Bicycle Railway.

RAILWAY EARNINGS in 1888, as reported by the *Financial Chronicle* for 127 companies comprising 80 per cent. of the total mileage, show net earnings of $235,000,000, a decrease of $24,000,000 over the net earnings of 1887. The bulk of the loss is on special roads and localities. In the Northwest 12 companies decreased $13,500,000 in net earnings; and in the Southwest, 7 companies decreased $4,500,000, which was nearly a third of their net earnings in 1887. Chicago, Burlington & Quincy of course heads the list of losers, with a decrease of $6,378,148 in net earnings; and the Atchison company comes next, with a loss of $3,460,380. Then follow Philadelphia & Reading, $3,187,857; Chicago, Milwaukee & St. Paul, $2,549,053; Chicago & Northwestern, $2,450,005; and New York Central $1,739,525.

On the other hand the systems which have benefited largely by the development of the Pacific Coast section have increased their gross earnings about $16,000,000, although their net increase was a little less than one million.

The Practical Calculation of the Heads, Diameters, and Discharges of Long Pipes.

(*Continued from Page 142.*)

BY E. SHERMAN GOULD.

Since each section of pipe must discharge equal volumes in equal times, it is evident that the respective velocities of flow must vary inversely as the areas of the pipes. These areas vary as the squares of the different diameters. Designating therefore by V the lowest rate of velocity, .4 c. ft. that of the water passing through the largest pipe (the 16-in. one), we obtain the relative velocities in the other pipes by multiplying V by the ratio of the square of the diameter of the largest pipe, to the squares of the other diameters. It will be convenient to form the following table:

Lengths in ft.	Diameters in ft.	Velocities in ft. per second.
500	$\frac{1}{2}$	1.78 V
800	$1\frac{1}{4}$	V
1400	$\frac{3}{4}$	4 V
600	$\frac{1}{2}$	7.11 V

Beginning at the lower end of the system, that is with the 6-in. pipe, and employing formula (1) in which h and V are the unknown quantities, we have,

$$\frac{1}{2} \times \frac{h}{600} = 0.00072 \times (7.11^2) \times V^2$$

whence

$$h = 43.68\ V^2$$

again:

$$\frac{2}{3} + \frac{(h' - h)}{1400} = \frac{2}{3} \times \left(\frac{h' - 43.68\ V^2}{1400}\right) = 0.00089 \times (4^2) \times V^2$$

whence

$$h' = 66.86\ V^2$$

similarly:

$$\frac{4}{3} \times \frac{(h'' - h')}{800} = \frac{4}{3} \times \left(\frac{h'' - 66.86\ V^2}{800}\right) = 0.00065 \times V^2$$

whence

$$h'' = 87.25\ V^2$$

Finally:

$$\frac{50 - h''}{500} = \frac{50 - 87.25\ V^2}{500} = 0.00066 \times (1.78)^2\ V^2$$

whence

$$V^2 = 0.7321$$
$$V = 0.8556 \text{ ft. per second}$$

Substituting this value of V^2 in the above equations:

$$h = 31.98 \text{ ft.}$$
$$h' = 48.95\ "$$
$$h'' = 49.23\ "$$

We also get the velocities in the different pipes, thus:

6 inch, velocity = $7.11 \times 0.856 = 6.086$
8 " " = $4 \times 0.856 = 3.424$
16 " " = $1 \times 0.856 = 0.856$
12 " " = $1.78 \times 0.856 = 1.524$

The work can be checked by using the above values of h, h' and h'', along with the other data, in (i), and obtaining the velocities in this way.

Thus, beginning with the 6 inch pipe:

$$\frac{1}{2} \times \frac{31.98}{600} = 0.00072\ V^2$$
$$V = 6.08$$
$$\frac{2}{3} \times \frac{16.97}{1400} = 0.00089\ V'^2$$
$$V' = 3.42$$
$$\frac{4}{3} \times \frac{0.28}{800} = 0.00065\ V''^2$$
$$V'' = 0.85$$
$$1 \times \frac{0.77}{500} = 0.00065\ V'''^2$$
$$V''' = 1.53$$

A very close agreement throughout.

In the above calculations the decimals have been carried out further than would ordinarily be necessary in practice. It was done in the present instance in order to avoid discrepancies in checking.

We have another check, in the volumes discharged. Thus, the discharge through the 6-in. pipe, with the given velocity is by (2)

$$Q = 0.196 \times 6.086$$
$$Q = 1.19 \text{ cubic ft. per second.}$$

All the other pipes should have an equal discharge for instance, the 12-in. pipe gives:

$$Q = 0.78 \times 1.524$$
$$Q = 1.19$$

In the preceding examples a series of horizontal pipes have been considered, the head being produced by an elevated reservoir placed at one end. The results would have been identical, however, if the head had been produced by the pipes being laid upon a slope, provided the difference of level between the 2 extremities remained the same, for the velocities and hydraulic grade line would remain unaltered. The pressure in the pipes would vary, however, according to their distance below the hydraulic grade line, the pressure being measured at any given point in the pipe line, by the vertical distance between such point and the grade line. If the pipes were laid exactly upon the hydraulic grade line, there would be no pressure at all in the pipes, and if they rose at any point above it, there would be either no flow or a diminished one, unless syphonage were resorted to.

In order to make this point very plain, we will consider the same system of pipes as that used in

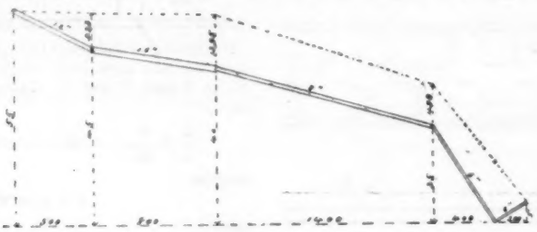


Fig. 6.

the last example, but laid as shown in Fig. 6, the upper extremity being fed by a constant supply, with only head enough to overcome resistance to entry, and produce initial velocity, which will be treated of further on.

Calculating precisely as before, we get the same hydraulic grade line, unbroken by the rising grade of the last 200 ft. of 6-in. pipe.

It is sometimes desirable to ascertain the uniform diameter of a pipe which shall be equivalent to a series of pipes of different diameters, such as we have just been studying. This may be done by an application of formula (4), which, for this purpose is written in the following form:

$$H = \frac{C\,Q^2}{0.616} \times \frac{L}{D^5}$$

As an example, let us calculate the diameter of a single pipe, of the same total length and fall as the series of pipes which we have just had under consideration, and capable of discharging an equal volume. We will first establish the general formula for all such problems, expressing the difference of level between the two ends of each pipe respectively, by $h_1\ h_2\ h_3\ h_4$, etc., their respective lengths by $l_1\ l_2\ l_3\ l_4$, etc., their respective diameters by $d_1\ d_2\ d_3$, d_4, etc., and their respective coefficients by $c_1\ c_2\ c_3$ c_4, etc., commencing with the lower end. We will express the total length by L, the total difference of level by H, the unknown diameter by D, and its coefficient by C.

Now, observing that the quantity discharged per second by each pipe is the same, we have the 4 equations.

$$h_1 = \frac{c_1 Q^2}{0.616} \times \frac{l_1}{d_1^5}$$
$$h_2 = \frac{c_2 Q^2}{0.616} \times \frac{l_2}{d_2^5}$$
$$h_3 = \frac{c_3 Q^2}{0.616} \times \frac{l_3}{d_3^5}$$
$$h_4 = \frac{c_4 Q^2}{0.616} \times \frac{l_4}{d_4^5}$$

Adding, and observing that the sum of the partial heads $h_1\ h_2\ h_3\ h_4$ equals H, we have:

$$H = \frac{Q_2}{0.616}\left(\frac{c_1 l_1}{d_1^5} + \frac{c_2 l_2}{d_2^5} + \frac{c_3 l_3}{d_3^5} + \frac{c_4 l_4}{d_4^5}\right)$$

but we have also the equation:

$$H = \frac{C\,Q_2}{0.616} \times \frac{L}{D}$$

whence, suppressing the common factor:

$$\frac{C\,L}{D^5} = \frac{c_1 l_1}{d_1^5} + \frac{c_2 l_2}{d_2^5} + \frac{c_3 l_3}{d_3^5} + \frac{c_4 l_4}{d_4^5} \quad \ldots\ldots (5)$$

The above is the general formula.

Substituting the special values of our example:

$$\frac{3300}{D^5} \times C = \frac{0.33}{1^5} + \frac{0.52}{(4\text{-}3)^5} + \frac{0.066}{(2\text{-}3)^5} + \frac{0.432}{(1\text{-}2)^5}$$

Giving a preliminary approximate value to C of 0.00066, we have

$$\frac{2.178}{D^5} = 0.33 + 0.123 + 7.335 + 13.824$$
$$D^5 = 0.1007$$
$$D = 0.65$$

This value of D indicates a practical diameter of 8 ins.

In order to check this value, we may write (4) under the form:

$$Q = \sqrt{\frac{D^5 \times H \times 0.616}{L \times C}}$$

Substituting given values:

$$Q = \sqrt{\frac{0.1007 \times 39 \times 0.616}{2.178}}$$

$Q = 1.193$ cu. ft. per second,

thus proving the correctness of the work.

These calculations can be abridged, and, in many cases, sufficient accuracy secured by adopting a mean common value for C. If we do so in the present case, C becomes a common factor, and disappears from the calculation, (5) becoming

$$\frac{L}{D_5} = \frac{l_1}{d_1^5} + \frac{l_2}{d_2^5} + \frac{l_3}{d_3^5} \text{ etc.} \qquad (5)\ bis$$

If this equation be worked out for the above given values, we have:

$$D = 0.64$$

or 8 ins. as before.

It will be observed that this process might have been used with advantage in the previous example, by ascertaining the discharge of an equivalent pipe, and then calculating the heads necessary to produce this discharge through the different pipes.

In calculating fifth powers and roots, a table of logarithms is almost indispensable. If none is at hand, it is well to remember that a number can be raised to the fifth power by multiplying together its square and cube. Fifth roots, in the absence of logarithms, can only be extracted by "trial and error," using the above rule for fifth powers.

(TO BE CONTINUED.)

Electric Railway Signals.

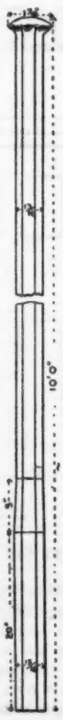
An electric railway signal, to be operated in connection with block signals now in use, and whereby the approach of trains within a predetermined interval between them will be instantly indicated to the engineers by an audible alarm which will continue until the proper interval is again maintained, has been patented by Mr. A. Z. BODA, of Columbus, O. The line would be equipped with a series of electric signals at suitable intervals, these signals being electrically connected with contact points placed at or near each signal station so that they will successively have electrical connection with contact arms on the locomotive. By these means a train passing any signal would set at danger the signals in both directions for a predetermined interval, and should a following train reach this signal before the former train had passed the next signal station, an audible alarm would be given in the cab of such following train. The system is intended as an additional safeguard to the present visible signals, the main purpose of the invention being to relieve enginemen from the attention and responsibility of detecting the positions of visible signals, by placing in the cabs audible alarms which will automatically give notice of danger.

It is also the purpose of the invention to so arrange the system of signals that an alarm will be given to the drivers of trains running in the same or in opposite directions, if they approach within the predetermined interval, so as to avoid danger of collision upon single-track lines. The system also comprises an audible alarm, operated by a battery on the train, the circuit of which battery is established at any signal station by the arrangement of signals which was produced by the preceding train, and which will remain until the train in front has passed the next signal station, and by so doing set the signals at the rear station to indicate a clear track, while at the same time the signals ahead will be set at danger. Provision would be made upon single-track lines for operating signals upon both sides of the line simultaneously and from either side of the engine, so that the presence of two trains upon the same or adjacent intervals would be indicated whether the trains were running in the same or opposite directions.

The Standard Railway Signal Co. has been incorporated at Columbus, O., to manufacture these signals. President, J. B. MCDONALD. Capital stock, $10,000.

Steel Sounding Rod, New Croton Aqueduct.

The accompanying illustration gives merely the exact dimensions of the sounding rod which, after considerable experimenting, has been found to give the most satisfactory results in practice in testing the brick arch of the new aqueduct, and detecting by sound the existence of the enormous vacuities behind the fair exterior which has been such an astounding feature of the aqueduct construction. Sounding over the interior with this instrument, if the masonry and backing be solid, it only gives out a dead sound; but if there be any vacuity there, gives out sound like a drum—not always proportioned to the size of the cavity, however, since some of the smallest cavities give forth the loudest sound. But as what is wanted is to detect every cavity, and as a small one is about as injurious as a large one, this does no harm. The total weight of the bar is 19 lbs.



A Diagram of the World's War-Vessels.

Lieut. R. P. RODGERS, chief of the Intelligence Bureau of the Navy Department, says *Science*, has arranged in his room a curious and important map. It is a large map of the world on Mercator's projection, and on its surface are pinned colored tags showing the present position of all the war-vessels of the world. British vessels are represented by red tags, French by light blue, German by purple, American by dark blue, etc., and their positions are daily so readjusted as to conform to the latest advices. By this pictorial arrangement the Secretary can in a moment sweep the seas, and ascertain exactly the whereabouts and the strength of the naval power of the world.

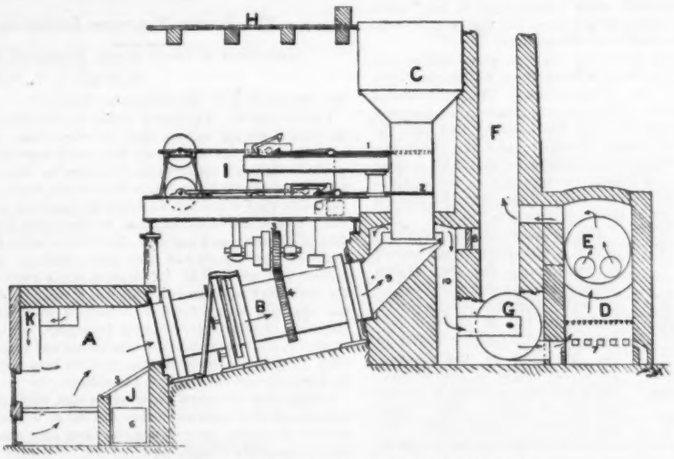
Of the ships indicated in commission on the map, about 150 belong to Great Britain, and 100 to France, while Germany and the United States have not more than 40 each. Italian ships are mostly in the Mediterranean; Spanish ships chiefly in the West Indies and at home. Germany has 3 warships at Samoa; the United States has 1, and 2 more on the way, in the aggregate superior to the German contingent. China has 12 or 20 ships, all on her own coast. She is not aggressive. In Central America we are outnumbered in a way to suggest that the Monroe doctrine is not to be enforced at once. We have at the Isthmus of Darien 1 rather poor ship on the east side, none on the west side. France has 1 on each side, and Great Britain has 3 on each side. We have 4 vessels on the West African coast, and 6 in the seas of the Orient.

MAYOR GRANT, of this city, thinks that the practice of building fires in the streets to thaw the ground so that excavations can be made, injures the granite block paving, and causes it to disintegrate.

The Foster Garbage and Refuse Cremator.

One of the questions that has been occupying the attention of sanitarians for many years has been the economic disposal of garbage and other solid refuse, especially that produced in our inland towns, where the rivers are either too small to have this waste material emptied into them, or other conditions make this mode of procedure impossible. One way of ridding communities of these troublesome products is that of cremation, and many furnaces have been invented with that end in view. In order, if possible, to utilize a larger proportion of the heat units of the coal employed, the apparatus shown in the accompanying cut has been designed by Mr. WOLCOTT C. FOSTER.

The material to be cremated is brought into the works on the floor *H*, and dumped into the receiving bin *C*. This floor is either on a level with the street, or else is approached by an inclined plane so



The Foster Garbage and Refuse Cremator.

that the wagons used for collection may be driven up to the bin, thus necessitating but one handling of the material. From the bin *C*, the refuse is automatically charged into the revolving cylinder *B*, by means of the doors 1 and 2. These doors are operated by the mechanism *I*, in such a manner that while one is open the other remains closed. The rate of charging may be varied at the will of the attendant. As the matter passes through the cylinder *B*, it is kept finely divided and at the same time constantly falling across the path of the heated and burning gases coming from the furnace *A*. If necessary, air may be admitted through the ducts *K*, and oxygen sufficient to cause the complete combustion of the material in the cylinder supplied. The cylinder is revolved by means of the gears 3 and 4, and its speed varied as is found desirable. The idea is to have the rate of revolution such that the refuse is wholly converted to ash by the time it reaches the lower end. From the lower end of the cylinder the ashes pass on to the grate 5 and fall into the pit *J*, from which they may be removed through the door 6. Any unconsumed matter is retained on 5, and being submitted to the direct action the offlames is rapidly destroyed.

By means of the blower *G*, a suction or inward draft is produced in all this part of the apparatus, thus preventing the escape of noxious fumes through leakage, or in case any of the doors are inadvertently left open. The path and direction of all gases throughout are represented by the heavy broken line and arrow-heads.

After reaching the blower, the gases are forced into the ash pit of the furnace *D* through the opening 7. They then pass through the fire of this furnace, and are converted into $C\,O$, $C\,O^2$, $S\,O^2$, $H^2\,O$, N, mainly, after which they pass on and finally out through the chimney *F*. Steam for the engine used in operating the machinery is raised in the boiler *E*. By opening the valve 8, *A* and *B* may be connected directly with the chimney should this for any reason become desirable. It is intended to use any cheap fuel, such as culm or slack, in the furnace *A* and *D*.

By properly regulating the rate of feed and the rapidity of the revolution of the cylinder *B*, the temperature of the gases, when they reach the flues 9 and 10, can be reduced to a minimum, thus utilizing the largest percentage of the calorific power of the fuel, and also fully employing the heat developed by the combustion of the garbage at the lower end of the cylinder.

Tenement Houses in Boston, Mass.

More than a year ago an executive committee of the Associated Charities, of Boston, Mass., started an investigation into the sanitary condition of the Eighth Ward of that city, and later extended this examination to cover the worst streets and alleys in the worst districts of Boston. Prof. DWIGHT PORTER, of the Institute of Technology, undertook the charge of the work, assisted by certain students of the Institute, and his report upon "A Sanitary Inspection of Certain Tenement-House Districts of Boston" is now published.

The plan of this work had been previously outlined by Prof. GEORGE F. SWAIN, and this plan, slightly modified, was the one used. The main object was the gathering of data regarding the sanitary conditions of the poorer laboring people of that city in the tenement-house districts. Under the law of 1885 a tenement-house is defined as one occupied by more than three families, living independently of one another, or by more than two families so living upon any floor above the second. Of the 910 houses examined, upward of 300 were tenement houses as above defined; though lack of time and means made it necessary to confine the inspection to the worst houses and districts The 910 houses contained a population of upward of 12,000 persons, or nearly one-seventh of the 89,000 inhabitants accredited in 1885 to the six wards visited.

Of the above total, 360 houses were reported to the Board of Health as appearing to be in unsatisfactory condition. It was found that the poorer tenants lived in apartments of two or three rooms each, for which they paid a weekly rental ranging from 50 cts. to $1.00 per room. The average total weekly rental of nearly 1,000 families was found to be $1.86. No individual house visited included more than 15 families or more than 60 or 70 inmates. They were about equally divided between wood and brick buildings, and about two-thirds of them had three principal stories; a very small number of tenement-houses were as high as six stories.

The overcrowding found was largely the result of poverty, and was the most common and aggravated among the Italians and Polish Jews; though in very many cases, especially among the people last named, this overcrowding seemed to be a matter of habit and choice. It was confined, however, to the occupancy by single families of apartments too small for them, and was not, as well as could be ascertained, shown in the herding together of several families in common apartments, as has been noted in London and even in New York. Assuming that 500 to 600 cu. ft. of air-space should be the minimum for each occupant of a room, and that this air is frequently changed, the inspectors found 208 tenement houses proper which contained upward of 4,500 persons. In these houses 194 rooms had 703 occupants, with an average air-space to each of 148 cu. ft.; 254 rooms had 778 occupants, with 233 cu. ft. of air to each; and only 65 rooms out of a total of 834 in these 208 houses gave an average of 522 cu. ft. of air-space per occupant. In the 432 houses reported as overcrowded, there was a population of about 7,000 living in 1,490 rooms. Of the latter, 327 rooms gave an average of 149 cu. ft. of air-space per occupant; 490 gave 236 cu. ft.; 323 gave 329 cu. ft.; 231 gave 427 cu. ft.; and only 119 rooms averaged 519 cu. ft. per occupant.

To better understand these statistics, which are not complete, it should be noted that the population of the city of Boston for 1885, divided by the acres of area within its limits, gives an average of about 17 persons per acre. But by taking the wards separately, and leaving out certain large areas of wharf and railroad property not available for dwellings, we find a population per acre ranging from 43 in Ward 11 to 230 in Ward 8. In comparison, the most densely settled ward of Chicago averages 86 persons per acre, and Ward 10 in New York had in 1880 over 430 persons per acre. But it is also easy to pick out in Boston certain blocks of one to one and one-half acres which, excluding street surface, average 600, 700, and even more persons per acre. Boston, Chicago, and New York have nearly the same areas, the figures being 23,085, 22,498, and 24,893 acres respectively; the population per acre in these cities is 16.9, 29.5, and 47.8 respectively. But to show that it is theoretically possible, with suitable buildings and oversight, to provide comfortably for even a denser population than any heretofore stated, the property of the Boston Coöperative Building Co. may be cited. Part of this property occupies an area of less than 7,000 sq. ft., with buildings as high as is desireable for tenement-houses, the space economically used, and so arranged that few could take exception to its adaptation for the health and comfort of the tenants. Yet the settlement on this area is at the rate of 1,200 persons per acre.

As might be expected, much filth and personal uncleanliness were found in the worst houses, and some frightful examples are noted in the report. The drainage systems were generally found to be so inaccessible as to make it difficult to even guess at their construction. Of more than 2,000 sinks examined, 60 per cent. were found to be not individually trapped. Of these only 1,000 were in tenement-houses as defined by the law.

As to disease, the report shows that in the years 1883-87, there was a total of 3,505 deaths and 18,780 reported cases from diphtheria, scarlet fever, and typhoid fever alone. A study of the Board of Health returns for the past 17 years shows the total death rate, or annual number of deaths from all causes, per thousand of population, to have ranged as high as 30 and as low as between 20 and 21. But no material permanent charge is noticed, for either better or worse, and the rate clings to figures comparing unfavorably with those for numerous others of the largest American cities. In a series of years the proportion of the total deaths due to zymotic diseases has ranged as high as 35 per cent. and as low as somewhat less than 18 per cent. The highest rate was in 1872, and since that time there has been an irregular but well-maintained decline. This decline, after substantially standing still in rate between 1877 and 1883, began afresh in 1884, the first year in the use of the Improved Sewerage System, and in the years 1885-86 there was a uniform and remarkable decline from 26.2 to 17.7 per cent. in the proportion of deaths from zymotic diseases.

The report recommends an increase in force of inspectors, as it is shown that the inspector for Wards 6 and 7 has under his charge 30,000 people of a very difficult class to manage. A number of provisions in the New York tenement-house laws are also pointed out which do not exist in the Boston laws and should be included. Landlords are greatly responsible for the lack of decent and healthful conditions on the premises. Their tenants are often very rough and undesirable, but they themselves as often look upon this property simply as an investment, with absolutely no regard paid to the welfare of tenants. Calculations made on about 40 tenement-houses proper showed returns of from 10 to 20 per cent. and some rose as high as 30 per cent. In several cases the annual rental exceeded the assessed value of the buildings.

Pole Road Locomotives.

Pole railways, or lines with a track made of round poles instead of rails, are extensively used in the lumber regions of this country, owing to their cheapness of construction and the equipment for such roads presents some peculiar features. The Pole Road Locomotive Co. has been organized at Richmond, Va., to acquire from the Richmond Locomotive Works the patents of W. E. COLE and others for rolling stock of this class. The engine is carried on four 30-in. wheels, with a very broad grooved tire to run along the log track. The cylinders are above the frame, and drive a shaft which has a pinion gearing with a spur wheel, on the shaft of which are small sprocket wheels connected by steel chain gearing with larger sprocket wheels on the driving axles. All the gearing is of steel, and the chains have a breaking strain of about 12 tons. The driving wheels revolve independently of each other, and have an independent lateral play. The gauge is 5 ft. 2 ins. from c. to c. of poles. The axles are mounted on double spiral springs, and the axle boxes can be adjusted in case of the chain stretching; axle-box sleeves and interchangeable bushings in the driving wheels enable repairs to be made easily and at little expense. Three sizes are built, with cylinders 6½ x10 ins., 7x12 ins., and 8x12 ins.; they weigh 22,000, 29,000, and 31,000 lbs. in working order. Water is carried in a saddle tank holding 350 to 650 galls. and the boiler is fed by two injectors. It is stated that the 8x12 engines will haul cars containing 8,000 to 10,000 ft. of boards, up grades not exceeding 150 ft. to the mile, at an average speed of 4 or 5 miles an hour.

The poles for the track are generally about 9 or 10 ins. diameter at the small end, and 13 ins. or more at the butt; the butt is hollowed out about 10 ins. to receive the small end of the next pole. Cross-ties are not necessary, but earth is well packed on each side of the pole. Curves must be flat. The cost of construction is estimated at $100 to $200 per mile, exclusive of timber, and branch roads can be built for $75 per mile.

THE WASHINGTON AQUEDUCT TUNNEL, according to the report of the Congressional Committee, submitted on Feb. 26, is an absolute failure in its construction. The report absolves the engineer officers of any corrupt practices or knowledge of corruption among the inspectors; but it charges them with great negligence in the discharge of their duties. The report states that there are not ten continuous feet of solid work in the tunnel. The committee are opposed to spending any more money on the tunnel, and make the startling recommendation of substituting a surface gravity conduit, for the reason that Congress never provided for a tunnel. The committee believe it will cost $900,000 to put the tunnel in good condition, and even then there will be great danger of percolation through the rock. The report concludes by suggesting that a new 48-in. main, laid at a cost of $575,000, will connect the reservoirs and provide an ample supply of water for ten or fifteen years to come.

CORRESPONDENCE.

The Ownership of a Railway Location.

COLUMBIA, S. C., Feb. 18, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Will you oblige several readers by giving your opinion on the following question? *A* is employed to make a survey of a railroad line for *B*, and furnishes him with map, profile., etc., reserving duplicates. *B* fails to build the line, but proposes to build a parallel line between the same points. *C* now employs *A* to make a survey of the same route. Would *A* have a right to furnish *C* with the notes of the original survey, without the consent of *B*? And if not, would he have a right to run over the same stakes, making, of course, notes identical with those of the first survey? W.

[In our opinion, as *A* was paid by *B* for his time and services in making the original survey, maps, and profiles, he has no right to sell to *C* the result of the survey even on duplicate maps or by using the same notes or stakes. But we do not see any valid reason for *A* declining to make an entirely new survey for *C* over a route abandoned by *B*, if all official connection is severed between *A* and *B*. The knowledge gained in any way by a civil engineer in the course of his regular practice belongs to him individually, where his original client has declined to secure the results of the work he paid for by occupation or otherwise. *B* purchased the engineering knowledge and services of *A* for a certain piece of work, and then abandoned the results obtained through this purchase. He certainly did not secure for all time the general or special "experience" of *A*.—ED. ENG. NEWS.]

Form of Level Nolds.

NEW YORK, Feb. 18, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Your reply to "G. E. C." in Notes, Queries and Answers, which appeared in your issue of Feb. 16, gives one no idea what systems of keeping level notes he advocated, but it suggests bringing to your notice a method adopted by a few engineers, including myself, who with many others were engaged in the survey and construction of the State railways now in operation in South Africa. It was known to us as the Collimation, and also the American method, although since I have been in the United States for the last 3 years, I have not met anyone who ever used the field-book of this method.

As will be seen from the example given below, the form of field-book used in this system of keeping level notes consists of three columns only. The *first* contains all the rod-readings: the *second* the height of collimation [height of instrument, ED.] "boxed-off," and also the elevations of all points observed; and the *third*, the stations, etc. Having the stations in the *third* column makes it more convenient for plotting, as the stations are then adjacent to their respective elevations instead of the rod-reading, as they would be if in the *first*.

	213.708	B. M.
3.213	216.921	
5.1	211.8	116
6.3	210.6	117
7.189	209.732	118
4.201	213.933	
7.5	206.4	119
8.517	205.416	tbm.

The elevation of the starting point is put down in the second column, and a line then drawn under it across the *first and second columns*. The backsight is placed under the line in the first column, and the reading added to the elevation of the starting point for height of collimation, and a line drawn under it across the *second column only*. This boxes-off the H. C., or H. I. (height of instrument). All the subsequent sights are placed under the backsight as they are taken, and their values subtracted from the H. I. for elevations, as in the general system of Henck's. When the last foresight or T. P. sight is taken, a line is drawn under it across the first two columns, and if the leveling is to be continued, the above operation is repeated. The line across the first two columns always denotes a Turning Point. At first it is rather awkward adding up the backs and fores for proof, but it is easily done after a little practice—the B. S. being always below the line and the F. S. above. Yours truly,

H. C. LITCHFIELD.

[This method is in principle the standard American practice. The only question is whether it is worth while to crowd all the notes into three columns merely to save space. Decidedly, we think not. The better form is six columns, Station, Backsight (+ sight), Height of Instrument, Foresight (— sight), Elevation (of stations), Bench. The separation of backsight and foresight is convenient for adding, and the separation of bench elevation and station elevation is convenient for making profile, while saving of paper is no object at all.—ED. ENG. NEWS.]

Cement-Lined Water Pipe.

NEW YORK, Feb. 21, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I notice an article in your last issue entitled "Cement-Lined Water Pipe," and without any desire to intrude upon your space, would respectfully suggest that it is a subject which is deserving of a thorough investigation. A properly manufactured cement pipe is far more suitable than iron for the purposes named; the only thing to be guarded against is that it be properly manufactured from a good Portland cement and sharp sand, and *that no Rosendale cement is mixed with it*. I think inquiry would prove that in all the cases of failure referred to, it was caused principally through the admixture of *Rosendale cement* with the Portland, the principles of the two cements being antagonistic to each other.

The opinions of those interested in the manufacture of cement pipe would form very interesting and useful reading. Respectfully yours,

E. W. FISHER.

Kutter still Ahead.

NEW YORK, Feb. 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In an old note-book, Mr. R. F. HARTFORD has found a formula resembling the one he recommended for sewers in 1885, dated as far back as 1872, and states that, unless I can show something prior to this date, he can justly claim the form as his.

Nothing is easier, as KUTTER first published his formula in the well-known periodical of the *Oestr. Ingénieur & Architecten Vereins* in 1869, including the abbreviated form now claimed by Mr. HARTFORD. KUTTER is therefore still ahead, and Mr. HARTFORD must relinquish his claim, unless he can find another still older note-book.

I am a little surprised at his apparently deriving the formula in question from that of BAZIN. This can only be done by an algebraic blunder. There is a "radical" difference between the two, BAZIN using $\sqrt{a + R}$ where KUTTER uses $(a + \sqrt{R})$, and he devotes several pages of text and a plate of plotted gaugings to show that BAZIN's form corresponds less well with the experiments than his own. As to whether the constants suggested by Mr. HARTFORD are more correct than those suggested by myself, is a matter of opinion. I do not care to say anything more on the subject. Yours truly,

RUDOLPH HERING.

The Lorini Traverse Diagram.

Department of Public Works, Engineer's Office,

YONKERS, N. Y., Feb. 19, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I have read Mr. KAHLERS' letter in your issue of Feb. 16, and it seems to me that, however true his statement in reference to his own discovery may be, his supposition that any contrivance for a similar purpose must have been copied from his, is, as you say, unfair. I have no doubt that when Mr. KAHLER first applied himself to the preparation of his diagram, he imagined himself the first in the field, as I also did. But I have made inquiries, and find that others had been there before. In 1864, a patent was granted to Mr. MASON for a traverse table for the use of navigators. This was almost identical with the diagram which JOHN W. NYSTROM published under the name of "Table for Solving Triangles," in the tenth edition of his Pocket Book of Mechanics and Engineering, 1867. Both had a movable arm, divided into parts corresponding to the divisions on the table.

I made my discovery some years ago, without having ever heard of or seen any other device of a like nature. Others, no doubt, have struck the same idea since, without being guilty of stealing from me. It is only recently that I have endeavored, at the suggestion of numerous friends, to give the profession, through the medium of your enterprising paper, the benefit of the Graphic Traverse Table in its present convenient form.

Yours respectfully,

M. LORINI, *Assistant Engineer.*

The Sayre, Pa., Syphon Trouble.

ROCKTON, S. C., Feb. 18, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

The difficulty with the syphon at Sayre, Pa., arises from one of two causes, or perhaps from both combined. There is probably an air leak at one or more of the many joints in a pipe of this length. If then leaks are on the descent from the summit toward the swamp, the effect would be more injurious than if beyond the summit and toward the discharge, the tendency of the current being to carry the air into the pipe in one instance, and to expel it in the other. Both are to be avoided, however.

Then, again, on account of the long draught, 444 ft. to summit, there is difficulty in keeping the discharge portion of the pipe *full* of water, and air creeps in above the water, there being a tendency to run out faster than pipe is filled from above. Let W. A. S. insert a plug of wood into the discharge end, reducing the opening from 4 ins. to 3 ins. by boring with an auger of this size through the plug. This may not be the exact size for the hole, but the idea is to have about the same quantity of water discharged under the pressure caused by backing up to the summit, that now flows through. If this does not remedy the defect, then he may rest assured that air leaks exist along the pipe. The quarries of the Winnsboro Granite Co. are drained by syphons, and in some instances, especially when the draught was long to summit, and fall small, I have succeeded by the above plan in keeping up a constant flow.

If the trouble is, as you suggest, aeration of the water as it enters the pipe, caused by the surface being too near the entrance of pipe 1 ft. above, let the 4-in. pipe be passed through the bottom of an inverted tub or half barrel, which should be made air-tight and extended into the water as low as the pipe. I suppose that it is impossible to lower the pipe? Very truly yours,

T. W. WOODWARD, *Manager.*

Rivet Symbols.

CINCINNATI, Feb. 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

As to the advantages to be secured by the adoption of a standard code of symbols for rivet heads there can be

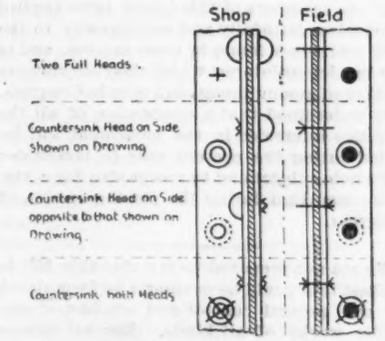
no doubt; but there appears to be room for quite a difference of opinion as to what symbols are best.

While the code proposed in your issue of Jan. 25 is very good, it seems to me inferior to the Pencoyd code published by Messrs. Wilson Bros. and Co. in your issue of Feb. 9. I agree with Messrs. Wilson Bros. and Co. that the various parties interested in the adoption of a standard code of signs should give a full expression of opinion, and the signs favored by the majority should be accepted, I beg, therefore, to offer the following suggestions:

First.—It appears to me that the customary +, marking the center, is the simplest and least laborious symbol to use for shop rivets with two full heads.

Second.—It appears to me desirable to have symbols for rivets in elevation, that is where both heads are shown on the drawing; as it often happens that a single section and a single view of a particular detail shows its construction clearly, and, unless symbols for those rivet heads appearing in elevation are used, it will be necessary to show another view of the detail for the purpose of indicating the rivet heads.

Third.—I would suggest that the symbol for shop rivets countersunk on the side opposite to that shown on drawing have a dotted outer circle, instead of a dotted inner circle. This corresponds better with the symbol for the field rivet; and it will be easier to dot the outer circle on small scale drawings.


Shop
Field
Two Full Heads
Countersunk Head on Side Shown on Drawing
Countersunk Head on Side opposite to that shown on Drawing
Countersunk both Heads

Pencoyd Rivet Symbols, Revised.

Fourth.—Would it not conduce to simplicity and clearness to indicate flattened heads by the same symbols used for heads countersunk and chipped; and simply put at one side ⅛, ¼, or ⅜ to show that the head is not chipped but left ⅛", ¼", or ⅜" high, as the case may be? I enclose a list of "Pencoyd" signs so revised.

Yours very truly,

WARD BALDWIN, Asst. Engr.

Rivet Symbols.

CANTON, O., Feb. 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Acting on the suggestion of Messrs. Wilson Bros. & Co., I enclose a sketch of a system of rivet signs.

It seems desirable to reduce the number of *forms* of rivet heads to a practical minimum to simplify the work in shop, to reduce the number of symbols to the range of a fickle memory thus avoiding repeated consultation of the rivet code in office and shop or the errors resulting from a neglect to do so.

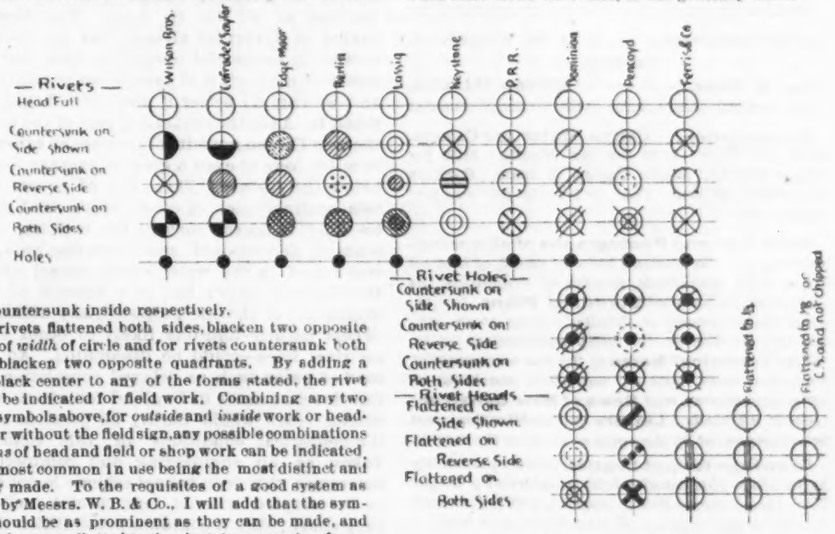
The forms given in codes you have published are, "Full head," "Flattened to ¼ in.," "Flattened to ¼ in.," "Flattened to ¾ in.," "Flattened to ¾ diam. of rivet," "Countersunk and Chipped," and "Countersunk and *not* Chipped." Total 7 forms. Reduce them to 3 forms thus: "Full head," "Flattened to ¼ in.," "Countersunk." But little can be urged in favor of a rivet flattened to ¾ in.; it is better countersunk and not chipped. As neither flattened nor countersunk rivets should be used when they can readily be avoided, the work will be none too good if the better form of the two is used in each particular case.

It is believed that in the simplified system enough errors would be avoided to counterbalance the extra cost of the few rivets countersunk instead of flattened to ¼ inch.

In regard to rivets countersunk and chipped, the construction of the drawing may show the necessity of chipping, or the single note "chipped" may be attached to a group of rivets to emphasize the requirement. Some builders may prefer symbol to chip all countersunk rivets and only make notes for those "not chipped." All systems seem to agree on the blank plan or full circle for a full-head rivet and the small solid black center for an open hole to be filled in the field; the double circle represents the plan of a rivet flattened outside or on face shown, and a number of parallel diagonal lines are quite commonly used to indicate rivets countersunk on face shown.

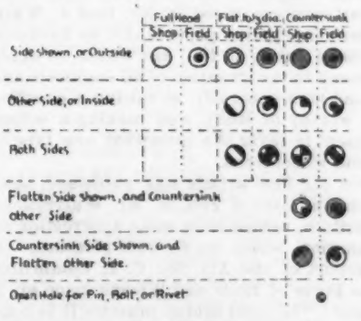
These four symbols are rational, distinct, and dissimilar, and as they are in common use, there is no reason for discarding them until it is known that they do not admit of rational additions to complete a code by symbols for all possible cases of rivets that are equally distinct, rational, and dissimilar, and about as readily made by free-hand additions to, and inside, the full circle; or until a system entirely new and covering all cases clearly and rationally has been devised.

By blackening about one third of the width of a full circle, a fair representation of the portion of rivet head flattened out can be made, and with one quadrant of the circle blackened, the countersink may be indicated. Let those two symbols be used for flattened on inside and countersunk inside respectively.



Conventional Signs for Rivets.

For rivets flattened both sides, blacken two opposite *thirds* of *width* of circle and for rivets countersunk both sides, blacken two opposite quadrants. By adding a solid black center to any of the forms stated, the rivet would be indicated for field work. Combining any two of the symbols above, for *outside* and *inside* work or head. With or without the field sign, any possible combinations of *forms* of head and field or shop work can be indicated, those most common in use being the most distinct and readily made. To the requisites of a good system as stated by Messrs. W. B. & Co., I will add that the symbols should be as prominent as they can be made, and *within* the area allotted to the rivet, to prevent as far as possible their becoming blurred under the greasy or rusty index-finger of the shop-man or confused with other matters exterior to the rivet. They should be as dissimilar as possible. Lines *intersecting* on rivet center, as well as horizontal and vertical lines through



Rivet Symbols.

rivet center, should be avoided, because they may be mistaken for lines used to locate a center line or rivet spacing. The symbols should be such that the draughtsman can at one setting of bow pen go over all rivets with full-line circles and afterward select the rivets to be specially marked. Dotted lines should be avoided as far as possible on account of extra time taken to make them, and for the same reason right lines, with an indefinite end either inside or outside the circle, should be avoided, because they cannot be made uniform without special care.

Respectfully submitted,

J. W. PEARL.

Rivet Symbols.

PENCOYD, Pa., Feb. 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

It may be of interest to some of your readers to illustrate the different systems of rivet signs, in comparison with the one proposed as a standard by G. W. FERRIS & Co., shown in your issue of Jan. 26. The necessity of having uniform signs has long been felt by those who carry out work from drawings made in different offices, each firm having its own system. Some of these signs show very plainly and distinctly on blue prints, but they require interpretation, which is objectionable, as without this explanation there is a liability to error in shop.

The system proposed as a standard, which the originators claim has advantages over any system heretofore in use, is questionable, as it is doubtful whether it will give as good results as others that have been in use for many years. Probably many firms have adopted it for the sake of uniformity only.

It is true that the cross lines on the inside and outside of circle convey the terms "inside" and "outside." But these terms are confusing, and can only be applied to rivet heads on double members, such as chords, posts, etc., and members that have their parts riveted close together can have no rivet head on the inside, both heads being on the outside.

The sign may indicate the rivet head on the outside and yet be on the inside of the member. On a drawing showing a section, these terms would not clearly indicate the position of the rivet head.

When these terms were used, it was generally understood that "outside" meant always this end of rivet, and "inside" other end of rivet, whether shown in section or elevation; but it seems that those who have adopted the new system differ about the meaning of the terms used, judging from the drawings made at different offices.

Cross marks are only arbitrary signs and don't indicate countersinking. The signs should not only indicate the position of the countersinking but also the countersinking itself.

To classify rivets not chipped among the flattened is liable to cause errors in the shop.

The templet-maker would pay no attention to the flattening, as it would not concern him, and he would be liable to overlook the fact that a ⅛-in. flattened rivet should have the hole countersunk, which error may not be discovered until the work is all riveted up.

The height of a flattened head is generally half the height of the full head.

The system used at the Pencoyd Bridge Works indicates countersinking by two circles, and their position by dotted and full lines, which have the same meaning as other lines of the same character on drawings, and can never, therefore, be misunderstood, no matter what terms are used.

It is also important that the signs for C. S. on either side should be easily convertible into the signs for C. S. on both sides.

The last-mentioned system has been in practical shop use for over ten years with the very best results.

Yours respectfully,

E. A. SCHNEIDER.

[We would explain to MR. SCHNEIDER that the publication of his previous communication of Jan. 29 on this subject was delayed, because the symbols, as then presented, required rearrangement and redrawing in our office, in the midst of a press of other work. The drawing sent with this letter is unexceptionable and a prompt issue is the result. —ED. ENG. NEWS.]

Notes, Queries and Answers.

W. R. H. We fear there is not enough interest in the refinements of exact measurements to make it worth while for us to publish the article.

C. A. H. inquires where he can secure a Tompson's Arithmometer, or computing machine; and if possible, the price. This is a French machine, we believe, but we do not know where it can be purchased. The Thacher calculating instrument, however, is a machine intended for the same purpose, and is well tested by use, and is operated with unexampled rapidity and accuracy. It is furnished by Keuffel & Esser, New York City. The price in a mahogany box is $30.

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D. McN. STAUFFER, A. M. WELLINGTON.
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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Regular meeting, March 4. "Strengthening Iron Bridges," C. E. Taylor. Secy., Kenneth Allen, 310 Baird Building.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Mar. 6. Secy., John W. Weston, Gaff Building.

American Society of Civil Engineers, New York.—Regular meeting, March 6. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, March 6. "Shortage on Coal in Car Lots," T. D. Miller; "Improving the Channel of the Mississippi." W. Alderdice. Secy., Wm. H. Bryan, 709 Market St.

Civil Engineers' Club of Cleveland, O.—Regular meeting March 12. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, March 13. Boston & Albany passenger station.

New England Water-Works Association.—Next meeting, March 13. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Engineers' Club, Philadelphia, Pa.—Regular meeting, March 16. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, March 19. Secy., S. M. Wickersham, Penn Bldg.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, March 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, March 21. Rooms, 113 Liberty St., New York City.

ABOUT two years ago Mr. HEMAN CLARK, well known as a builder of public works, proposed to solve the question of rapid transit through and between New York and surrounding cities by a tunnel sunk 150 ft. below the ground level. Little attention was paid to the project at the time, owing to its enormous cost of $30,000,000 and the supposed engineering difficulties standing in the way of successful completion, and operation when completed. But Mr. CLARK now announces that a capital of $150,000,000 stands ready to guarantee the scheme. Whether we regard this announcement as a bit of newspaper talk, or as an evidence of the blind faith of capitalists in anything that looks "big," the scheme itself has some promising possibilities that are worth discussing.

No engineer need be told that a tunnel through the solid rock substratum of this city would cost less money than a tunnel only a few feet below the street level, even when allowing a very liberal percentage for the contingency of water in this rock and the shutting out or pumping that this water may require. The deep tunnel would be free to follow any alignment, regardless of roadways or surface property; and at the depth of 150 ft. its constructors might pass under water as well as under land; American elevators already provide a means of safe and speedy transfer of passengers from the tunnel to the surface; and finally right-of-way, that costs so enormously above ground if any other line than that of the streets is selected, should cost practically nothing at all 150 ft. down. The Mersey tunnel at Liverpool already has an elevator service in successful operation, each car capable of conveying 50 passengers at one time, and we can do better if necessity should demand it. As to the tunnelling part of the work, the new Croton aqueduct furnishes an example 30 miles long at even a greater average depth below the surface. There are of course certain contingencies of construction that must be duly weighed, such as the meeting of a seam of decomposed, water-bearing rock, as was found in the water-works tunnel under the Harlem river; but in a scheme of the magnitude of the one proposed, any difficulty of this nature—and one likely to occur only on river lines—could be discounted. An inroad of water such as delayed completion on the Severn tunnel in England for about seventeen years would hardly be possible with the geological conditions of this vicinity. Taken as an engineering and commercial enterprise, this deep-tunnel scheme is not one to be adopted without very careful preliminary study; still it contains possibilities that make its study well worth the expenditure of very considerable time and money.

WE have been unable to find space this week for the completion of our discussion of the flat rail question raised by Mr. DON J. WHITTEMORE's interesting paper which we have now published nearly in full, and which we again commend to the attention of all engineers and railroad men generally, as raising a question well worthy of study, and making a strong argument in favor of a somewhat new type of rail and wheel tread.

Since our first article was published, however, in our issue of Feb. 16, Mr. WHITTEMORE has written, asking us to make a correction or explanation, which we do with pleasure. In the report of the Am. Soc. C. E. Committee on the Form of Rails and Wheels (page 40) it is stated: "In good bridge practice it is considered entirely safe to load steel rollers rolling on steel up to the equivalent of 10,000 lbs. per linear inch for a 33-in. wheel." To this statement Mr. WHITTEMORE in his paper took exception; and in our recent discussion just referred to, we in turn excepted to the exception, stating that the value given was computed directly from Mr. WHITTEMORE's own formula as given at the foot of the table of "Average Crushing Strength of Metals" on page 438 of Trautwine's Pocket Book.

The reference reads, "Solid cylindrical steel rollers under bridges and rolling on steel are safe with $\sqrt{}$ diam. in ins. $\times$ 3,100,000 in lbs. per linear inch of roller parallel to axle. And" (various other cases), the whole credited to "Specifications for Iron Drawbridge at Milwaukee, by DON J. WHITTEMORE, C. E.," so that the original statement objected to would seem to be justified, but Mr. WHITTEMORE writes us explaining the apparent conflict, as follows:

The formula $\sqrt{D \times 3{,}100{,}000} = P$ was one specified for Sellers' center, which was intended to apply to solid case-hardened rollers on similarly hardened surfaces, and shortly after this was brought to my notice as conforming to the practice of Mr. SELLERS, I was informed that rollers designed in accordance with the formula, crushed. Trautwine should have specified that this formula was intended to apply to the Sellers' centre, having specially hardened rollers and surfaces.

The formula I issued in my specifications for steel wheels on steel track, you will find in Trautwine as follows:

$$P = \sqrt{D \times 1{,}300{,}000}$$

We must in our turn take exception to any attempt to apply the same formulæ to car-wheels and rails and to rollers under bridges, as entirely unwarranted by similarity of conditions, but for the present we merely note the exception, in connection with this correction.

THE Cullom-Breckenridge bill for the establishment of a Bureau of Harbors and Waterways has been favorably reported upon in the House, after having passed the Senate last session. Our readers are already familiar with the scope and purposes of this measure, and the Executive Board of the Council of Engineering Societies on National Public Works are to be congratulated upon having accomplished more than the profession generally supposed was possible. The best evidence that the members of this board have applied themselves faithfully and intelligently to the task set them is found in their success, and in the auspicious interest which their efforts have awakened among thoughtful men in Congress. It is understood that a convention of all the societies interested in the movement will be called during the present year to reconsider the whole subject and to reorganize for a vigorous campaign during the coming session of Congress.

WE are not prepared to say that this bill is the best that could be or should be formulated for the general control and conduct of our public works of all kinds. But all things must have a beginning, and as a beginning, this will serve. We stand alone among the great nations of the world in failing to systematize and concentrate the control of our public works in some one distinctive department. But there is some hope even in a proper bureau organization; for, this once accomplished, it requires only time and the application of common sense and business instinct to convince our law-makers that all such bureaus should form one department and be under one executive head. For this reason we are glad to see the movement progressing, and regard this progress as an auspicious omen for the immediate future. The present mixed and costly division of control, in all that relates to government engineering works, cannot possibly last much longer, and it only remains to so mould any legislative action that what is done shall be for the greatest public and professional good. Engineers, very naturally, can do much in shaping action on the professional side of this question; and it is to be hoped that no one will neglect his opportunity.

IN connection with a late article on aluminium, appearing in this journal, and as an answer to inquiries sent in, we would say that as far as known by Mr. W. J. KEEP, one of the best authorities on this subject, the Deville process is the only one in use for the commercial production of aluminium. Many improvements have been made and Mr. J. W. RICHARDS has published all that are known. In a report which has been widely circulated in the technical journals, he has discussed the action of aluminium upon the carbon of cast-iron, and a later report will soon be issued. Much of what has been written regarding the wonderful strength and manifold uses of aluminium is purely visionary. The cast metal is much less strong than that which is rolled or hammered. The best description of this metal, in a condensed form, is to be found in the 9th edition of the Ency-

clopœdia Brittannica. CHARLES T. WHITE & SON, 96 Maiden Lane, New York City, sell pure aluminium at $7.00 per pound; they are the agents for The Aluminium & Magnesium Fabrik Co., of Bremen. The Pittsburg Reduction Co., of Pittsburg, Pa., offers pure (96 per cent.) aluminium at $5.00 per pound in any quantity, even to ton-lots for immediate delivery. The Cowles Co., of Lockport, N. Y., appears to be the principal producer in this country at present. All stories as to any exceedingly cheap process of manufacture must be taken with many grains of salt.

THE controversy before a committee of the Connecticut Legislature between representatives of the Housatonic and the New York, New Haven & Hartford Railway Companies is nearing a close. As noted on our last week's Engineering News page, the point at issue is the permission which the Housatonic Company asks to build a parallel line to the New York, New Haven & Hartford from New Haven to New York City. The bill presented authorizes the Housatonic Company to build branches not more than 30 miles in length and to borrow money for their construction by an issue of bonds to an amount of not more than one-half the actual cost of construction and equipment. Another bill authorizes the company to purchase all the rights and franchises of the New York & Connecticut Air Line Railway Co., and extends the time limit for the construction of that road to Dec. 3, 1893.

It is uncertain whether the counsel for the New York, New Haven & Hartford Company will be able to convince the legislators of the fact that the building of a railway to closely parallel a road already existing, and able to carry all the traffic offered, is an unwise waste of capital, and contrary to the public welfare; and that the competition which is expected from its construction must, from the nature of the case, be merely temporary, and must finally result in the consolidation of the competing roads. The question is complicated by the fact that the Housatonic asks no greater privileges than other railway companies already possess under the general railroad law, but of which the Housatonic is deprived by its charter limitations. The officers of the Housatonic, therefore, can justly claim that they are asking for no special privileges, but merely for the same right that their competitors already possess. The residents of Norfolk, and of some other towns which expect benefit from the proposed extension, are of course strongly in favor of it; and a powerful influence will be brought to bear to induce the passage of the bills.

IF the Housatonic is to be permitted to build a competing road from New Haven to New York, however, the permission should manifestly be accompanied by certain requirements. A competing railway between New Haven and New York must be principally important as a passenger route. It is especially necessary, therefore, that a new competing line should be required to be so built as to secure a high standard of safety to the passengers it is to carry. If it is to compete with an established road, let it not do it at the risk of the lives and limbs of its passengers; but let its line be, at least approximately, equally safe with its competitors'. It may justly be required, therefore, that the proposed road shall be a double track, rock ballasted line, with iron or masonry bridges, no grade crossings or wooden trestles, and with no curves sharper than 3° or 4°. Provisions regarding the mere comfort of the passengers might perhaps be left safely to the judgment and self-interest of the managers; but it is the manifest duty of the legislators to see that on a road with so heavy a passenger traffic as this must needs have, if it is to repay the cost of its construction, no trifling with the safety of life and limb is permitted; and they can, therefore, justly require that only a first-class road shall be built. Whether permission to build at all should be granted or not, is another matter.

IN explanation of some statements in the article on the Vancouver water-works, in our issue of February 2, we would state that we have recently seen documents which show that the original contractor for the Burrard Inlet pipe-laying was, as is too often the case, another victim of "most careful soundings" and neatly lettered cross-sections.

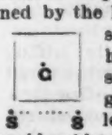
MR. GEORGE A. KIMBALL, Chairman of the Board of Engineers, whose admirable report on the abolition of highway grade crossings in Massachusetts we reviewed last week, calls our attention to the fact that the apparent omission of 20 crossings from the estimate of cost of removal, to which we alluded as a probable oversight, was intentional, it not being proposed to remove them at all because their peculiar location near to wharves, etc., made the cost exceed the probable benefit. The wording of the context led us to infer that the crossings thus neglected were on spur tracks, etc., and so had not been included in the previous tabulation, but this, it appears, was not the case.

The Bicycle Principle for Railways.

We are unable to take any other view of the attempt to work railways on the bicycle principle, illustrated and described in outline in this issue, than that it is a most interesting experiment, deserving of the careful attention of engineers, as possibly destined to lead to important consequences. Mr. BOYNTON and the gentlemen who are associated with him in the experiment may not be the proper persons to bring it to a successful issue, even if it admits of such. The chances are always against any particular man or set of men having that peculiar combination of level-headed and cautious discretion, business sagacity, and mechanical insight and knowledge which is necessary to secure speedy success from any radical departure. The blind enthusiasm of the inventor is very apt to destroy caution, or a too skeptical caution, to deaden the equally necessary enthusiasm. Many claims have been made to us, and probably to others, in respect to this new departure, which we regard as extravagant and even absurd, and have therefore in part suppressed from our account.

But allowing this to be so, it by no means follows that the "ground idea" may not be both practicable and important, and there are certain strong reasons for believing that it may be such which we propose to summarize, and for which we bespeak careful attention.

From the remote antiquity when some unknown benefactor of his race invented the wheel until now, the elements of every vehicle designed for practical use are sufficiently outlined by the little triangular diagram at the side of this column. Two wheels have rested upon two points of support, *S S*, and the center of gravity of the vehicle, *G*, has fallen midway between them and a considerable distance above them. Such a vehicle, standing or moving, is always in stable equilibrium, unless so greatly tilted that a perpendicular from *G* falls outside of one or the other *S*, when the vehicle tips over. Unless the motion be too fast, so as to cause bouncing, very great irregularity of support is necessary to cause such overturning, so that for slow speeds such a vehicle will go almost anywhere, and seems difficult to improve upon.



But for any approach to high speed the conditions become very different. A much more uniform supporting surface becomes indispensable, and to see the reasons therefor we may go at once to the extreme of high speed and of smooth support, a railway train and track.

If we regard the points *S S* as two parallel rails, we can see at once that as soon as there is the slightest irregularity of level (*i. e.* as soon as one of the supports *S* is for the instant taken away) there is nothing for it but for the body *G* to lurch over *laterally* until the lost support comes to a bearing again; in other words, the *direction* of motion must be instantaneously changed, and this involves what is popularly known as a "lurch" against the low rail. This lurch is apt to be so forcible, requiring as it does a second change in the direction of motion, as to cause a rebounding impact against the opposite rail; and so, under unfavorable conditions, the process may go on for some time or even continuously. At extremely high speeds it does go on continuously, on the best track.

There is no practical trackman who has made a study of the matter who does not understand this sequence of cause and effect very well, from practical experience. Really good track should have the rails absolutely level or (on curves) with an absolutely uniform cant. It is far more important to secure this than longitudinal uniformity, as any one can soon see who will seat himself at the rear end of the train and watch how quickly and certainly a lateral lurch will succeed any disturbance of level. All trackmen do not understand as well as they ought the extreme importance of such perfection of level, and hence do not take as much pains as they should to keep a perfect level, but a great deal of work is constantly devoted to it.

The seriousness of the evil referred to increases nearly or quite as the square of the speed. It is not felt greatly at slow speeds, but how great it becomes at high speeds is indicated in a measure by the conclusion of a recent editorial in *The Engineer* to which we may have occasion to refer again shortly, as it discusses an article of our own:

> In conclusion, we may quote the words of a very able locomotive superintendent in reply to the question, "Why is it that a locomotive cannot be driven faster than about 80 miles an hour?" "Because no driver will venture to run at a higher speed. I have myself stood on the footplate of a light engine running at 80 miles per hour. There would not have been the least trouble in running faster, if I had dared. But 80 miles an hour is a tremendous pace. The permanent way is violently strained. The superelevation on curves is not sufficient. If anything gives way, or the engine should leave the track, that simply means sudden death for all concerned. The risk might cheerfully be run if there was anything to be gained in return, but there is nothing to be gained; and however greedy a man may be for high speeds, when standing on the footplate, 80 miles an hour will, according to my experience, satisfy the greediest, and leave something to spare."

We must not be assumed to assent to *The Engineer's* statement that "there would not be the least trouble" in running faster than 80 miles an hour, except on a down grade, but to 60 or 70 miles per hour the statement undoubtedly applies.

It is obvious also that, so long as the principle of support remains as outlined in the diagram above, any narrowing of the space between supports *S S* will only aggravate these evils, because, if one of the supports be for the instant taken away, the angular lurch to recover it is likely to be greater, and the center of gravity *G* is so far at one side of the remaining support *S* as to forbid any maintenance of stability by the bicycle single-sup-

port system, which requires *G* to be vertically over *S* to come into action.

What is the bicycle principle, and to what extent does it afford rational hope of better conditions? The bicycle proper is a very modern device, as we have outlined in another column, so that few of our readers had a chance to learn to ride it in their boyhood; but in the older form of the child's hoop, the same principle of stability is familiar to every one.

The hoop is probably a toy nearly as old as the wheel itself, and the essence of its motion is that when it is propelled forward, it tends of itself to maintain a vertical position, *i. e.*, one with its center of gravity directly over the point of support. In rolling on a curve, in like manner, it tends of itself to assume an inclined position, so that the resultant of gravity and centrifugal force shall pass through its point of support. Why it does this, in apparent contradiction of the laws of statical stability, we need not stop to inquire. It is easily enough explained theoretically, as the gyroscope has been, after the event; but the most learned man who had never seen one, would probably hesitate to evolve from his inner consciousness such a theory of motion, for either gyroscope or hoop, as every child discovers practically.

The ease with which a hoop is rolled is not increased, but rather decreased, by making it a broad, flat band, so that it will stand upright when still. The easiest hoop to roll is a perfectly round wire giving support only from a point. Without a forward rolling motion, such a hoop cannot possibly be made to stand vertically. With it, it cannot be made to assume any other position, except by a blow so violent as to destroy the rolling motion altogether, but if distracted from its vertical position instantly and automatically returns to it. The youngest children, consequently, whose untrained muscles lead to all kinds of sidelong and glancing blows, roll hoop with perfect ease, almost on the first trial.

In view of the obvious analogy between their laws of motion, it seems odd that it should have taken mankind some unknown thousands of years to advance from the hoop to the bicycle; but not till a score of years ago does it seem to have occurred to any one that the same conditions which maintained the hoop in vertical equilibrium would be likely to still maintain it so, even if a load were carried above it, supported from its center. The experiment was tried in 1869, however, with measurable success, but not till a decade or so ago was the modern single-wheel bicycle (for it is only a single wheel mechanically) invented and proved successful. With this wheel, as every one knows, not only can direct motion in a straight line be maintained without the slightest tendency to tip over while forward motion is maintained, but curves are easily turned and the most complicated circular evolutions performed in a small space, not as a trick of balancing acquired by long practice, like walking on a tight rope, but as a natural and easy extension of the art of rectilinear motion. As soon as the bicycle is caused to move in a curve by turning the wheel, new conditions of equilibrium arise, by which the wheel tends to maintain a certain inclined position, as before a vertical, but under substantially equal and similar laws.

Not only is this so, but expert riders can even do all this with a single large wheel, without the small rear wheel by which, in the ordinary bicycle, their position on top of the wheel is maintained. This latter performance, of course, is a trick of balancing, like tight-rope walking, and it requires something of an acrobat to do it. But many can do it, for an indefinite length of time, while making complicated manœuvres; and that it should be possible to do it at all under such conditions, illustrates how simple and automatic must be the action of the forces by which lateral equilibrium is maintained.

Now if it is possible to do this with a bicycle carrying a load and propelled by human muscles or gravity, why is it not possible to do it with a bicycle propelled by steam and loaded with the weight of the boiler and steam engine? Of course, as stability depends on the existence of rapid forward motion, and that motion ceases at stations, and is liable to have to cease at any moment, from accidental causes, provision must be continuously made by overhead rail and guide-wheels, or otherwise, for support in case of need. Otherwise, if the vehicles stop they will at once tip over. But a provision of this kind, which is only called into action in case of stoppage or sudden casualty is one thing: an overhead rail which was continuously relied on for support is another and quite a different thing. In the latter case, the conditions might not be greatly more favorable for smooth motion than on ordinary double-rail track. In the former case, the top guide-wheels need not be in contact with the overhead rail at all, except at stations, and hence there is much less necessity for exact construction or great strength and durability, and the evident possibility of maintaining much higher speed with smooth motion; because the faster the speed the stronger should be the natural forces tending to maintain verticality, if the bicycle principle be in fact capable of such extension, and the action of these forces is perfectly smooth and uniform. All we need, therefore, in such a case, is to have the overhead guide-rail wide at stations, so as to be in contact with over-head guide-wheels, and narrower between stations so as to be just out of contact with them, and we have conditions covering both requirements at once.

There is also the important question, to what extent the hoop or bicycle principle is applicable to a vehicle guided by flanges and rolling along a rail, and hence incapable of slight diversions from one side to the other. It is claimed, with no little plausibility, that the true secret of the motion of both the hoop and the bicycle is that whenever the least tendency to tip over arises, the wheel turns or is turned to one side, and the centrifugal force thus generated restores verticality, and that, without this power of ready lateral diversion, the vehicle would at once tip over, despite the apparent ease with which it maintains forward motion.

The ease with which a bicycle is ridden on a tight rope, and various other considerations, tend to decrease the importance of this point, even theoretically, to an extent which we shall consider at a later day, but at present it does not seem of practical importance to do so, because whether this theoretical obstacle to purely "bicycular" motion along a rail be sound or not, the existence of the overhead rail which is necessary in any case reduces its practical importance to very small proportions. There is no doubt that a bicycle or hoop in rapid motion requires an almost imperceptible guidance or diversion from a straight line to restore verticality, and an equally trifling amount of guidance from the overhead rail will in any case perform the same office for a "bicycular" train. It is to be remembered that the least tendency to tip over in such a train causes the upper part of it to move in a curve horizontally, and so generate centrifugal force which tends to restore it to verticality.

The possibility of such an important extension of our means of fast locomotion as that outlined is certainly good enough *a priori* to warrant full investigation and experiment. We hope this preliminary work is already in good hands, but even if not, we should not the less watch the experiments with critical interest to see whether the failure is unavoidable or due only to defects of detail. The advantages to be gained, should the bicycle principle prove capable of such extension, are many and great. Among them are: 1. The great increase in smoothness of motion at high speeds, permitting an almost indefinite increase of speed without danger in this respect. 2. A diminished air resistance, due to the narrower vehicles and running-gear. 3. A narrower and cheaper road-bed, both to construct and to maintain; and possibly, 4. Greater ease in passing curves. These are enough to now consider, but it is apparent likewise that the overhead rail would afford especial facilities for electric propulsion, and that for rapid transit lines the method, if practicable at all, would be particularly suitable.

It does not by any means appear to us that all the details of this experiment have been happily worked out, and there may well be obstacles to such an extension of the bicycle principle which have not yet occurred to us. We think it quite likely that this is the case. But we see no reason why they should prove insurmountable, and we cannot but feel a strong hope that the bicycle is capable of extension, from a mere plaything and toy, into an important working machine, after those tedious preliminary experiments and disappointments which every rational man expects in such cases.

The Water-Works of the North Central States.

Included in the North Central States are the five States of Ohio, Indiana, Michigan, Illinois, and Wisconsin. While these five States offer a close general similarity of conditions, the following tables show likewise some striking differences. The tables are given the same numbers as the corresponding tables of our previous reviews,* distinguishing them by adding to the number the letter *E*.

To an even greater extent than in the preceding group of States, as is natufal, the water-works interest of this group is a very recent creation. Before 1851, only 7 water-works existed in the whole group. In the next decade, 1851-61, only 3 others were added. In the war years, 1861-66, only 1 work was added in the whole region, and that a very insignificant one at Salem, O., with a pump of 6 × 12 ins. In the three succeeding years, to 1869, only 2 others were added, so that at that date there were only 13 water-works in this whole group.

Then began the rapid progress. In the next two years, 1869-70, the number of works was more than doubled by the addition of 14 works. In the next decade, 1871-80, 80 were added; in the next half-decade, 1881-85, 87 more; while in the past 2½ years there has been added the great total of 135, including 2 unknown, which probably belong to this period. Comparing with other sections, we have:

Number Water-Works opened.	No. Cent.	Southern.	Middle.	New Eng.
Before 1851	7	14	30	12
Decade ending 1860	3	5	34	16
" " 1870	17	4	33	32
" " 1880	80	21	118	76
7⅛ years " 1888	222	82	218	150
A total of	329	128	433	286
Per cent. in last 7⅛ years	67.5	64.0	50.3	52.4
" " " 17½ "	91.9	80.3	77.4	79.0

*Those desiring to refer for comparison to our previous reviews of the water-works of other sections, will find the review for the New England States in our issues of Oct. 13-20, 1888; Middle States, Dec. 15-22; South Atlantic and South Central States, Feb. 9, 1888.

The details of this record are shown more fully in Tables 1-E and 2-E. The last two lines above are significant, especially in the close equality in ratio of increase between the South and the North Central States, and in the small difference in rate of recent progress in all the sections. The figures show clearly that the South is now marching to the same tune of progress as the rest of the Union, because, although the number of works there seems small, yet, as will be seen from Table 6-E, the ratio of water-works to city population is about the same as in other sections. This appears still more clearly from the following.

The number of water-works recorded as now proposed, with fair prospects of construction, is much smaller than in the South, or even in New England. There now now proposed:

In Ohio	4			
" Indiana	4			
" Michigan	2			
" Illinois	7			
" Wisconsin	4			
Total North Central group	21	against	329	existing.
" Southern "	40	"	128	"
" New England "	25	"	286	"
" Middle "	19	"	433	"

This shows a percentage of only 6.4 against 31.2 per cent in the South, 9 per cent. in New England, and 5 per cent. in the Middle States. It is probable, or we may even say quite certain, that in each group the actual additions of 1889 will largely exceed these aggregates, but the contrast from any point of view shows how the South is catching up.

The first water-works in each of the States was: *Ohio*, Cincinnati, 1820, with no second till 1835, and no other large works till Cleveland, 1856. *Indiana*, Madison, 1849, with no large works till Indianapolis, 1870. *Michigan* Detroit, 1827 (the oldest in the Northwest), with Grand Rapids, 1840, and Kalamazoo and Jackson, 1869-70. *Illinois*, Chicago, 1840, with no other till 1860; Springfield, 1866, and Peoria, 1868. *Wisconsin*, none till Milwaukee, 1873, with only 7 others before 1885. All these are dates of opening the works. Some were probably under construction, and perhaps partially in use, a year or two before.

Table 4-E shows that this North Central group may be more evenly compared with New England than with any other group. With considerably larger population, there is nearly the same (a little less) mileage of mains, only about 80 per cent. as much capital invested, about 5 per cent. more revenue, and nearly 15 per cent. more works. The number of taps is also about 15 per cent. greater.

Table 5-E, showing status by decades, is less interesting and valuable than we hope to make it next year, from the fact that it shows only the *present* status of works first opened in each decade. Next year we shall show the actual status of works at the end of each decade. From the table it appears that the 7 works existing in 1850 now represent 15.3 per cent. of the total invested in water-works, leaving only 64.7 per cent. for the remaining 322 works. They also represent 39.3 per cent. of the revenue, 26.3 per cent. of the pipe mileage, 48.3 per cent. of the taps, and 31.4 per cent. of the population supplied.

It is not generally realized how much smaller a State Indiana is than Ohio and Illinois, and an examination of Table 4-E and especially Table 7-E shows that its water-works status compares anything but favorably with the rest of the group in other respects likewise. Whether or not this be because its "floaters" prefer to float in some fluid other than water, and have an ingrained antipathy to the latter, we cannot undertake to discuss in these columns.

In Table 6-E Indiana does not show so badly. Its rate of increase in total population has been the smallest of any of the group, and its per cent. of urban population is also the smallest; but the ratio of total population in water-works to the 1880 urban population is above the average of the group, which is singularly uniform. The group as a whole compares as follows with others:

	No. C.	So.	Mid.	N. Eng.
Per cent. of pop'n on water-works, to 1880 urban pop'n	111.9	107.1	113.1	120.6
Per cent. of urban to total population	24.0	8.9	47.2	49.6
Total pop'n, 1880, millions	11.206	12.863	11.756	4.015

This shows that, while comparison of water-works with the total population would show very great inequality, in proportion to town population the groups show a very remarkable uniformity of conditions.

Table 7-E shows the proportion of towns of various size supplied with water-works, the number of water-works in towns of 3,000 or under being in

Ohio	17	or	23.6 per cent.
Indiana	10	"	23.8 "
Michigan	50	"	60.9 "
Illinois	46	"	51.7 "
Wisconsin	14	"	35.0 "

Michigan is decidedly the banner State of the West for small works, probably in part owing to more and better sources of supply, which may be noted in Table 10-E, in our next issue. The group as a whole compares with other groups as follows:

	No. Cent.	Southern.	Middle.	New Eng.
Towns of 1,000 or under	10.8	17.2	10.9	13.9
" 3,000 "	42.2	40.1	51.0	41.8
" 5,000 "	63.0	60.6	69.0	64.3
" 10,000 "	83.8	78.6	87.0	81.2

The proportion of small works is still small, even by the 1880 population, and if we could use the 1888 population for each section, the relative proportion of small works would appear smaller, since the towns of this group have presumably been increasing faster in population than either the South or the Northeast. We have a shrewd suspicion, however, based on the indications of these statistics, that the politicians are going to have another surprise in 1890 like that which they had in 1880, by finding that the growth of population in the South has been very much faster than was expected. We shall be surprised if the Southern groups have not increased considerably faster than the North Central.

The list of towns in this group which had 4,000 population or over, in the 1880 census, but still have no water-works, is longer than in any other group, despite the presumably greater growth since 1880, to which we have just alluded. No less than 15 towns, aggregating 77,519 population in 1880, are included in this list, only one of them having projected works, against only 6 such towns in the South, two of which had projected works, and an equally short list in the other two groups. The list of these towns is as follows: Some of them may be improperly included by omissions on our part, but if so, we shall be pleased to be advised of that fact. The term "indefinite" means that projects have been reported for them, but appear to have fallen through.

Gallipolis,	Ohio	4,400	(indefinite)
Marietta	"	5,444	"
Pomeroy	"	5,500	(projected)
Van Wert	"	4,079	
Aurora,	Ind	4,435	
Lawrenceburg,	"	4,008	
Seymour	"	4,250	(indefinite)
Coldwater,	Mich	4,681	"
Monroe	"	4,900	
Ypsilanti	"	4,984	(indefinite)
Braidwood,	Ill	5,524	
La Salle,	"	7,847	
Peru	"	4,632	
Neenah,	Wis	4,282	
Watertown	"	7,883	
		77,519	

(TO BE CONTINUED.)

THE CONTRACTS FOR THE NEW COAST DEFENSE ship call for 5,400 H. P. from 431 tons of machinery, or about 12½ H. P. per ton, a very high proportion. The armor is to be 16 ins. thick.

Standards for the Analysis of Iron and Steel.

A committee of Section B, consisting of Professor ROBERTS-AUSTEN, F. R. S. (chairman), Sir F. ABEL, C. B., F. R. S., Prof. LANGLEY, Mr. EDWARD RILEY, Mr. G. J. SNELUS, F. R. S. Mr. JOHN SPILLER, Prof. TILDEN, F. R. S., and Mr. THOMAS TURNER (secretary), has been appointed by the British Association, says the *Iron and Coal Trades Review*, to consider the best method of establishing international standards for the analysis of iron and steel. It is proposed that the committee shall co-operate with other similar commitees in the more important iron-producing countries, in order to provide standard specimens of iron and steel, whose chemical composition shall have been carefully determined. The specimens adopted as standards shall be entrusted to some recognized official authority, such as the Standards Department of the Board of Trade, and shall be used either for reference in determining the accuracy of any proposed method of analysis or for controlling the results of analysis, in any cases of importance which may from time to time arise. The following are the suggestions offered for the guidance of the committee:

1. Professor J. W. LANGLEY, of the University of Michigan, U. S. A., to be requested to superintend the production of the samples; that they be prepared and preserved in accordance with the directions to be furnished by the committee, and that an equal portion of each sample be forwarded to the several secretaries of the respective committees in the United Kingdom, America, France, Germany, and Sweden.

2. The specimens which are eventually to be adopted as standards to be supplied to not more than 7 representative chemists of repute in each of the countries above mentioned, who shall be requested to analyze the specimens by any method or methods they may prefer.

3. In the event of the analysis giving results which in the opinion of the committee may be regarded as sufficiently concordant, the means of the analytical results of each of the several constituents to be adopted as representing the composition of the standards. The report on the analytical results not to be issued before the various analysts, to whom the samples have been submitted, shall have had an opportunity of examining it. The standards hereafter to be distinguished only by letters or numbers.

4. The attention of the committee to be for the present confined to 4 samples of steel, selected as containing, as nearly as possible, 1.3, 0.8, 0.4, and 0.15 per cent. of total carbon respectively. In addition to the determination of the amount of carbon present in each condition, the phosphorus, sulphur, silicon, manganese, and chromium also to be determined.

5. One hundred and fifty kilogrammes of samples selected for examination as standards to be prepared. This would give, after allowing sufficient for the required analysis, quite 5 kilogrammes of each standard for each of the 5 countries interested. Allowing, say, 10 grammes for each applicant who may desire to use the standards, this would permit of 500 appeals to each of the 4 standards in each country, or at least 10,000 appeals in all.

6. The samples to be analyzed in the United Kingdom by Mr. W. JENKINS, Dowlais; Mr. ED. W. RILEY, London; Mr. J. E. STEAD, Middlesbrough; the Royal School of Mines; Mr. G. S. PACKER, of the Steel Company of Scotland, and two others.

7. The metal of which the samples are to be produced to be cast in small ingots, special care being taken to prevent any irregularity of composition. After the removal of the outer skin, the metal to be cut by a blunt tool into the form of thin shavings, then crushed, sieved, and intimately mixed.

8. The samples thus prepared to be preserved in separate small quantities (say of 30 grammes each), which shall be hermetically sealed in glass tubes so as to prevent oxidation.

9. These preliminary arrangements of the committee to be communicated to the leading technical journals.

AN additional subscription to the KUTTER fund, of $12 from the Senior Class in Engineering of Princeton College, through Prof. CHAS. MCMILLAN, has been received, and will be duly forwarded, with any other further subscriptions.

TABLE 1-E.

NORTH CENTRAL STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.						YEAR.	Water-Works Built.					
	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.		Ohio.	Ind.	Mich.	Ill.	Wis.	Total.
Before 1800	....	....	....	....	....	....	Br't forward.	11	5	6	5	0	27
1800-10	....	....	....	....	....	....	1871	1	1	2	1	....	5
1811-20	1	....	....	....	....	1	1872	4	....	3	1	....	8
1821-30	....	....	1	....	....	1	1873	3	5	1	3	1	13
1831-40	1	....	1	1	....	3	1874	2	1	....	6	....	9
1841-50	1	1	....	....	....	2	1875	1	3	2	3	....	9
1851	....	....	....	....	....	....	1876	1	2	1	6	1	11
1852	....	....	....	....	....	....	1877	....	1	1	1	1	4
1853	....	....	....	....	....	....	1878	(1) 1	....	2	1	....	(1) 4
1854	....	....	....	....	....	....	1879	3	2	3	1	1	10
1855	....	....	....	....	....	....	1880	1	1	3	1	....	6
1856	1	....	....	....	....	1	1881	2	1	2	2	....	7
1857	....	....	....	....	....	....	1882	6	....	8	(1) 6	2	(1) 22
1858	....	....	....	....	....	....	18 3	3	....	8	3	1	15
1859	....	....	....	....	....	....	1884	5	1	6	5	1	18
1860	....	1	....	1	....	2	1885	2	2	5	6	9	24
1861	....	..	....	....	....	....	1886	(1) 5	9	9	9	3	(1) 35
1862	1	....	....	....	....	1	1887	(1) 6	2	6	9	9	(1) 32
1863	....	....	....	....	....	....	1888	12	7	15	19	11	64
1864	....	....	....	....	....	....	Unknown.	1	....	1	.....	....	2
1865	....	....	....	....	....	....	T'tal No.Cent.	(3)70	43	84	(1)88	40	(4)325
1866	....	....	....	1	....	1		Main.		Subs.		Total	
1867	....	....	....	....	....	....							
1868	....	....	....	1	....	1	T'tal No.Cent.	325		4		329	
1869	2	1	1	1	....	5	" N. Eng.	254		32		286	
1870	4	2	3	....	....	9	" Middle	406		27		433	
Carried f'd.	11	5	6	5	0	27	" S. Atl.	73		0		73	
							" So. Cent.	54		1		55	

Subsidiary water-works, viz., those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems are enumerated above in (parentheses). There are but 4 in the North Central States.

TABLE 2-E.

NORTH CENTRAL STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Date given is that of completion of works.]

DATE.	Ohio.	Ind.	Mich.	Ill.	Wis.	Totals.	Grand Total.
1811-20	1	.....	.....	.....	.....	1	1
1821-30	.....	.....	1	.....	.....	1	1
1831-40	1	.....	1	1	.....	3	3
1841-50	1	1	.....	.....	.....	2	2
1851-55	.....	.....	.....	.....	.....	.....	.....
1856-60	1	1	.....	1	.....	3	3
1861-65	1	.....	.....	.....	.....	1	1
1866-70	6	3	4	3	.....	16	16
1871-75	11	10	8	14	1	44	44
1876-80	(1) 6	6	10	10	3	(1) 35	36
1881-85	18	4	29	(1) 22	13	(1) 86	87
1886-88	(2) 23	18	30	37	23	(3) 131	133
Unknown.	1	.....	1	.....	.....	2	2
Total.	(3) 70	45	84	(1) 88	40	(4) 325	329

TABLE 3-E.

NORTH CENTRAL STATES WATER-WORKS. MAIN DETAILS BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of Works OPENED *in each Decennial or Quinquennial Period.*

[N. B. The figures opposite each date must not be taken as representing the conditions of the works at that date, but merely as the *present condition* of works then existing.]

DATE.	Present pop'n of water-works.	No. of Works. Total.	Present Finances. Cost.	Present Finances. Revenue.	Miles of mains.	Number of Taps.	Number of Hy-dr'ts.	Number of Me-ters.
OHIO.								
1820-50	265,365	3	$8,765,368	$705,023	319.00	36,072	2 997	1,283
1851-60	160,146	1	5,053,091	394,154	252.00	22,658	2,517	1,525
1861-70	121,812	7	2,822,134	176,164	169.00	9,681	1,277	584
1871-80	158,792	(1) 17	3,558,000	307,657	246.30	12,735	1,852	511
1881-85	116,418	18	2,426,851	215,217	227.53	9,323	1,748	202
1886-88	96,566	(2) 23	3,151,500	229,817	230.63	5,473	2,023	74
Unknown.	1,216	1	10,000	2,000	3.00	100	20	....
Total	940,315	(3) 70	$25,786,944	$2,030,032	1,447.46	96,042	12,434	4,179
INDIANA.								
1849-50	8,945	1	$250,000	$7,000	12.00	703	240	.....
1851-60	2,730	1	60,000	15,000	7 00	300	75	.....
1861-70	84,479	3	692,000	118,729	104-00	2,499	809	150
1871-80	169,843	16	2,584,400	214,232	226-20	11 250	1,984	273
1881-85	23,975	4	4-1,000	41,415	42-00	1,583	433	10
1886-88	77,358	18	1,589,800	132,380	136-95	4,510	1,207	63
Total	367,330	43	$5,657,200	$529,256	528-15	20,842	4,746	496
MICHIGAN.								
1827-50	148,356	2	$4,121,453	$406,068	348-00	33,138	1,569	44
1851-60	.....	..	....	... .	.....	.....	....	....
1861-70	34,108	4	783,847	46.148	55-50	5,125	541	39
1871-80	106,086	18	2,548,990	202.448	237-85	11,941	1,970	713
1881-85	71,306	29	1,246.612	130,568	142-46	5,468	1,298	11
1886-88	70,470	30	1,245,000	79,295	181-44	4,645	1,536	36
Unknown.	1,783	1	8,000	800	3-00	500	15	....
Total	432,109	84	$9,923,902	$865,327	967-25	60,817	6,929	843
ILLINOIS.								
1840-50	503,185	1	$11,393,422	$1,529 102	638-23	100,000	5,899	3,273
1851-60	7,834	1	100,000	5,000	4.00	125	30	... ..
1861-70	50 983	3	1,023,000	72,535	83.00	4.950	519	85
1871-80	153,160	24	3,186,153	385,034	417.84	19,432	2,062	683
1881-85	126,782	(1) 22	2,656.120	290,633	282-60	19,145	2,061	604
1886-88	103,548	37	1,946.918	216,125	150 40	4.743	1,336	21
Total	955,492	(1) 88	$20,305,613	$2,498,429	1,576.07	148,395	11,907	4,761
WISCONSIN.								
1873-80	137,908	4	$3,215,841	$305,190	169-50	15,584	1,394	1,736
1881-85	83,428	13	1 781.228	159,315	154-20	5,069	1,105	56
1886-88	94,150	23	2,789,700	371,070	194-12	5,714	2,031	14
Total	315,486	40	$7,786,769	$835,575	517-82	26,367	4,530	1,806

TABLE 4-E.

NORTH CENTRAL STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-E.

State.	Pop'n on Water-Works 1880 census.	No. of Works.	Present Finances. Cost.	Present Finances. Revenue	Miles of Mains.	Number of Taps.	Number of Hy-dr'ts	Number of Me-ters.
Ohio	940,315	73	$25,786,944	$2,030,032	1,447.46	96,042	12,434	4,179
Indiana	367,330	43	5,657,200	529,256	528.15	20,842	4,746	496
Michigan	432,109	84	9,923,902	865,327	967.25	60,817	6,929	843
Illinois	955,492	89	20,305,613	2,498,429	1,576.07	148,395	11,907	4,761
Wisconsin	315,486	40	7,786,769	835,575	517 82	26,367	4,530	1,806
Total No. C.	3,010,732	329	$69,460,428	$6,758,619	5,036.75	352,463	40,546	12,085
T'l So. Atl. & So. C.	1,220,358	128	$27,918,703	$2,491,120	1,623.20	98,636	12,120	5,454
Total Middle	6,165,618	433	156,522,264	15,027,661	7,428.03	890,021	56,005	33,991
Total N. Eng.	2,409,350	287	84,992,725	6,412,624	5,290.70	305,404	32,300	37,913

TABLE 5-E.

NORTH CENTRAL STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL NORTH CENTRAL STATES WATER-WORKS, AS GIVEN IN TABLE 3-E.

DATE.	Present pop'n of water-works.	No. of Works.	Present Finances. Cost.	Present Finances. Revenue.	Miles of Mains.	Number of Taps.	Number of Hy-drants.	Number of Me-ters.
1820-50	945,851	7	$24,530,243	$2,647,193	1317.23	169,910	10,705	4 600
1851-60	170,710	5	5,213,091	414,654	263.00	23,063	2,622	1,525
1861-70	291,382	17	5,250.981	413.576	411.50	22,255	3,146	858
1871-80	735,780	80	15,083,384	1,414,561	1297.69	70,942	9,360	3,916
1881-85	421,909	87	8,591,811	837,148	848.79	40,588	6,645	978
1886-88	442,092	133	10,722,918	1,028,687	893.54	25,085	8,133	208
Unkno'n	2,909	2	18,000	2,800	5.00	600	35	.....
Total.	3,010,732	329	$69,460,428	$6,758,619	5036.75	352,463	40,546	12,085

N. B.—This table does *not* represent the status of the works at the several dates (except as to number) but the statistics for the *current year* 1888, of works *first opened* at the several dates.

TABLE 6-E.

NORTH CENTRAL STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.]

STATES.	Total Population. 1870	Total Population. 1880	Total Population. Inc. per cent.	Urban Populati'n 1880.	Per cent. of total.	Pop'n on Water-works, 1888. Total by 1880 Census.	Pop'n on Water-works, 1888. P. C. of Total pop'n.	Pop'n on Water-works, 1888. P. C. of Urban pop'n.	Av. pop'n on each water-works.
Ohio	2,665,260	3,198,062	19.9	892,114	27.8	940,315	29.4	105.4	12,880
Indiana	1,680,637	1,978,301	17.7	327,248	16.5	367,330	18.6	112.2	8,520
Michigan	1,184,059	1,636,937	38.2	353,230	21.6	432,109	26.3	122.3	5,140
Illinois	2,539,891	3,077,871	21.1	844,462	27.4	955,492	31.1	113.1	10,740
Wisconsin	1,054,670	1,315,497	24.7	272,733	20.7	315,486	24.0	115.7	7,887
Total No. C.	9,124,517	11,206,668	22.8	2,689,787	24.0	3,010,732	26.9	111.9	9,140
Tot. So. Atl. & So. C.	9,947,361	12,883,119	58.8	1,140,015	8.9	1,220,358	9.5	107.1	9,530
do. Middle	9,848,415	11,756,053	19.4	5,538,720	47.2	6,165,618	52.5	113.1	14,220
do. New England	3,487,924	4,010,529	15.0	1,989,239	49.6	2,409,350	59.8	120.6	8,391

TABLE 7-E.

NORTH CENTRAL STATES.—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

STATES.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over.	Total No.
Ohio	4	13	20	21	8	6	72
Indiana	1	9	13	10	8	4	42
Michigan	15	35	14	10	5	3	82
Illinois	11	35	10	19	11	3	89
Wisconsin	4	10	11	7	7	1	40
Total No. Cent.	35	102	68	67	36	17	325
T'tal So. Atl. & S.C	21	39	14	22	11	15	122
do. Middle	47	174	78	78	24	32	433
do. New Eng.	40	80	68	48	35	19	287

1 duplicate system in Ohio, 1 in Indiana, and 2 in Michigan reduce the totals by so much. Separate towns supplied by one system are regarded as one town.

PERSONAL.

Mr. JAY GOULD has resigned his position as a Director of the Delaware, Lackawanna & Western.

Mr. WM. FARRELL has been appointed Superintendent of Water-Works at Salt Lake City, Utah.

Mr. MELLEN has been appointed General Traffic Manager of the Union Pacific.

Mr. H. H. FILLEY, M. Am. Soc. C. E., of Kansas City, Mo., will return from Mexico early in March.

Mr. J. T. ODELL, General Manager of the Chesapeake & Ohio, has resigned.

Mr. J. A. DRAKE has been appointed Secretary and Treasurer of the Indiana, Illinois & Iowa, vice Mr. E. FLETCHER, resigned.

Col. HENRY A. SHORTER, President of the Alabama Railway Commission, has been reappointed for another term of four years.

Mr. WEBB FINLEY and Mr. THOMAS BONNER, of Tyler, Tex., have been appointed Receivers of the International & Great Northern.

Mr. GEORGE D. EGERT, for about 30 years Roadmaster of the Utica & Black River road, died at Utica, N. Y., Feb. 19.

Mr. ROBERT BURGESS has been appointed Resident Engineer on the San Luis Potosi division of the Mexican Central Railway, with headquarters at Aguas Calientes, Mexico.

Mr. W. H. BALDWIN, Jr., has been appointed Superintendent of the new division of the Union Pacific made by the consolidation of Leavenworth, Topeka & Southwestern railway and the Kansas Central.

Mr. J. H. REDMON has been appointed Superintendent of the Central Iowa Railroad, which was taken out of the receiver's hands March 1, and turned over to the reorganized company.

Mr. CHARLES H. HUBBELL, Superintendent of the Southwestern Division of the Chicago, Kansas & Nebraska, was married at North Adams, Mass., Feb. 21, to Miss Reid, of that city.

Mr. H. L. HIGDEN, for the past two years Chief Engineer of the Austin & Northwestern, with headquarters at Burnet, Tex., has resigned to accept a position on the Victoria branch of the Southern Pacific, and Mr. W. J. CLAYBORNE, of Chicago, has been appointed his successor.

Mr. W. D. EWING is to be made General Manager of all lines owned and controlled by the Mackey Syndicate, and G. F. EVANS, now General Manager of the Louisville, Evansville & St. Louis, is to be made General Superintendent of the same.

Mr. RUDOLPH HERING, the well known sanitary engineer, has been in Atlanta, Ga., investigating the possible sources of water supply for that city. An official report will follow on the termination of surveys now in progress.

Mr. THOMAS G. MERRITT, Superintendent of Bridges and Buildings on the Cincinnati, New Orleans & Texas Pacific, died at New Orleans recently. He went to Mexico a few years ago, with D. B. ROBINSON, Superintendent of Construction of the Mexican Central and other roads. Later he returned to the United States and built the long Northeastern bridge across Lake Pontchartrain.

Mr. J. L. MURPHY has been appointed General Freight, Passenger and Ticket Agent of the Newport News & Mississippi Valley Co.(eastern division) with headquarters at Lexington, Ky., vice Mr. W. W. MONROE, resigned. Mr. S. A. BROMBERG is appointed Assistant and Soliciting Passenger Agent, with headquarters at Lexington, Ky. Mr. W. B. DARROW is appointed Car Accountant, with headquarters at Lexington, Ky., vice Mr. S. A. BROMBERG, transferred to other duties.

Mr. W. E. WORTHEN is to make the surveys and a complete topographical map of the Croton water-shed above the line of the proposed Quaker Bridge Dam with sufficient margin beyond the crest of the shed to define the anticlinal slopes, on a scale of 3 ins. to the mile, on which will be accurately laid down the highways, railroads, dwellings, manufactories, streams, lakes, ponds, and swamp areas, areas of woodland exceeding 10 acres in extent, and the contour lines at vertical intervals of 20 ft., for the sum of $7,000. The size of the map is to be 6 ft. by 4 ft. 6 ins. within borders; the map covering the whole area to be delivered within 100 days from Jan. 23.

Mr. WM. H. BURR, Chief Engineer of the French Company of Venezuelan Railways, was erroneously stated in our recent notice to have been formerly connected with the Panama *Railroad*. It was the Panama *Canal*, as well as the Pennsylvania Railroad and Mexican National, with which Mr. BURR was connected. We may add that Messrs. Kunhardt & Co., 32 Beaver St., New York, are the New York agents of the company, to whom communications may be addressed. There are no further vacancies for engineers on the line at present.

Mr. C. J. BRYDGES, Land Commissioner of the Hudson Bay Co., died at Winnipeg, Manitoba, on Feb. 17. He was an Englishman, and went to Canada some 49 years ago, at the age of 24, having distinguished himself as an able railroad man in England, and became General Manager of the Great Western Railway. In 1863 he severed his connection with the Great Western, to accept the position of General Manager of the Grand Trunk, which position he held until 1868, when, in company with AQUILA WALSH, Hon. Mr. CHANDLER, and W. F. COFFIN, he was appointed one of the commissioners for the construction of the Intercolonial Railway. Mr. BRYDGES afterwards became manager of the road, which position he held for several years, resigning it to become Land Commissioner for the Hudson Bay Co.

Mr. WILLIAM S. BARBOUR, M. Am. Soc. C. E., City Engineer of Cambridge, Mass., died at Cambridgeport, Feb. 24. Mr. BARBOUR was 54 years of age, and was born in Boston, but shortly afterward his parents removed to Cambridge, where he had lived continuously ever since. He studied his profession in the office of J. C. CHASE, formerly City Engineer of Cambridge, and at one time was the senior member of the firm of BARBOUR & HODGES, Civil Engineers, having offices in Cambridge and Boston. He was chosen in 1875 to the office which he filled with such signal ability up to the time of his death, and each year his re-election was unanimous, showing the value at which his services were placed. He performed his onerous duties with the object, seemingly, of best serving the interests of Cambridge, and during his career some very important and intricate engineering matters had passed successfully under his direction, notably the construction of the Stony brook improvements, the system of a trunk sewerage throughout the city, and the laying out of Front St. as the approach to the new Harvard bridge. In all these undertakings he had the hearty support of the authorities and of the citizens.

Messrs. ALBERT BEYER and THOMAS H. MCCANN have formed a partnership under the firm name of BEYER & MCCANN for the purpose of conducting the business of civil engineering, architecture, and surveying, with offices at Hoboken, N. J. They will undertake the following specialties: partition of estates; surveying (city and suburban); borings for foundations, etc.; water-works; public improvements; sewerage and drainage; dock, harbor and trestle-work; plans and estimates for public and private buildings; heating, ventilation and sanitation, etc. Mr. BEYER has designed and had charge of many of the principal public improvements constructed in Hoboken and the northern section of the county during the last 22 years, and has also planned and superintended the construction of many private and public buildings. Mr. MCCANN has had a practice of over 20 years in the various branches of civil engineering in New York City, and in Hudson county, N. J., and was for many years chief of staff in the office of Messrs. SPIELMAN & BRUSH and Mr. CHAS. B. BRUSH, Civil Engineers, of Hoboken, having been identified with these gentlemen in submarine, hydraulic, dock, harbor, and sewerage works, and in topographical, insurance, and general surveying.

Sir JOSEPH BAZALGETTE, C. B., for many years Engineer to the Metropolitan Board of Works of London has retired. Among his achievements as an engineer may be noted the Victoria and Albert Embankments and the plans for the new sewage disposal and precipitation works at Barking and Crossness. Sir JOSEPH was born in 1819, commenced the practice of engineering in 1842, and since 1847 has been officially connected with the drainage of London. In 1852 Sir JOSEPH was appointed Chief Engineer of the Commission having in charge the sewerage of London. He is entitled to the credit of commencing 25 years ago the construction of subways under new streets for the reception of gas and water pipes. The entire value of the street improvements for the engineering of which he was responsible amounted to over $60,000,000. Sir JOSEPH BAZALGETTE was President of the Institute of Civil Engineers and has been knighted and made a Companion of the Bath for his professional services.

PUBLICATIONS RECEIVED.

—*Exhibit of the Navy Department*, at the Centennial Exposition of the Ohio Valley and Central States, Cincinnati, Ohio, July to October, 1888. Navy Department, Washington, December, 1888, Lieutenant RICHARD RUSH, U. S. Navy Representative.

—*Proceedings of the U. S. Naval Institute*, Vol. XIV. No. 4. Contents:—Necessity and Object of a Naval War College, Capt. A. T. MAHAN. Notes on Steel Inspection, Lieut. Com. J. G. EATON. Tactics of the Gun, as discoverable from Type War-Ships, Lieut. J. F. MEIGS. Study on Fighting Ships, Prof. JULES LEHOUX. Naval Administration, Rear-Admiral LUCE. Messing the Crews of Men-of-War, Lieut. D. DELEHANTY. Notes on the Literature of Explosives, Prof. CHAS. E. MUNROE.

—*History of Education in North Carolina*. By CHARLES LEE SMITH. Bureau of Education, Washington, D. C., 1888.

—*Industrial Education in the South*. By Rev. A. D. MAYO. Bureau of Education, Washington, D. C., 1888.

—*Thirtieth Annual Report of the Railroad Commissioners of the State of Maine*. For the year ending Dec. 1, 1888. D. N. MORTLAND, A. W. WILDES, ROSCOE L. BOWERS, Commissioners. Pamphlet 9x5½ ins. 96 pp. Published by the State.

The Maine Commission shows that it is up to the times by some pertinent remarks on the live subjects of train heating and lighting and the removal of grade crossings. The frugal legislators of Maine value so highly the services of their State Railroad Commission that they allow them the munificent compensation of $5.00 per day for time actually spent. This sum has to be paid "by the railroads on which their services are rendered." According to the report, there are now 1,270 miles of railroad in the State.

Journal of the American Society of Naval Engineers, February, 1889, No. 1, vol. I.

This is the first issue of the publication of the newest of American technical societies, and its contents promise exceedingly well for the usefulness of this organization These include—Progressive Trials of the Steam Barge of the Commandant of the New York Navy Yard, by Chief Engineer B. F. ISHERWOOD; Duty and Capacity tests of High Service Pumping Engine, Washington, D. C., by Passed Assistant Engineer G. W. BAIRD; Some Problems in Propulsion, by Assistant Engineer W. D. WEAVER. Notes on Coals of the Pacific Coast, by Passed Assistant Engineer C. R. ROELKER; Increase of Horse-power for a Given Speed due to Foul Conditions of Ships Bottom, by Assistant Engineer, W. M. MCFARLAND. All of these are officers in the United States Navy.

SOCIETY PROCEEDINGS.

Engineers' Club of St. Louis.—At the meeting on Feb. 20, WHITFIELD FARNHAM, E. L. GOLDSTEIN, F. S. INGOLDSBY, and R. H. PHILLIPS were elected members.

Prof. JOHNSON, of the Committee on Highway Bridges, reported that in conjunction with the committee from the Kansas City Club a revised bill had been submitted to the Legislature. Mr. JOHNSON then read a paper on "Cast-Iron; Strength, Resilience, Test, and Specifications." The author had devoted a great deal of time and study to the investigation of this question and had made numerous experiments in the Washington University Testing Laboratory. He showed that the tensile strength varied from 17,000 to 36,000 lbs. per sq. in., and that from 20,000 to 25,000 lbs. tensile strength should be required. He showed that experience did not bear out the commonly accepted theory that the outside portion of a casting was stronger than the inside. In his opinion, the resilience, or the ability of the casting to withstand shocks, was by far its most important characteristic. He showed that repeated shocks resulted in a loss of resilience and that the Heisler testing machine, which is in use in the East, was open to objection on this score.

The secretary read a brief discussion by WM. B. KNIGHT of Prof. JOHNSON's paper on cable yokes. The author gave some data from Kansas City cable roads, showing that the strength of the yokes did not affect the slot closure. In some places it had been found necessary to break the yoke in two at the bottom, which had caused no bad results. He even thought that a good road could be built without yokes. In the discussion Mr. THOMAS MCMATH stated that at all the cable crossings of the Citizens' road, in St. Louis, the yokes had been separated without trouble. It was also stated that this was not an infrequent occurrence. Prof. JOHNSON stated that the gentlemen deserved credit for the courage of their convictions, and suggested that if some one would go a step further, and build a cable road without yokes, it would settle the matter. Mr. BOUTON stated that the continued closure of slot might be due to action of frost on the concrete tube, and the accumulation of dirt between it and the soil, which prevented its recovering its original position.

WM. H. BRYAN, *Secretary*.

New England Water-Works Association.—The regular quarterly meeting will be held at Young's Hotel, Boston, Mass., March 13. Hon. CHESTER W. KINGSLEY, of Cambridge, will address the association upon "The Relation of Great Ponds to our Water Supplies." This to be followed by a continuation of the series of brief "Experience Talks" commenced at the last meeting.

HIRAM NEVONS, *President*.
R. C. P. COGGESHALL, *Secretary*.

Master Car Builders' Association.—The Committee on Standard Axles for 60,000 lbs. car have issued a circular asking the following information: 1. How many cars of 50,000 lbs. capacity have you in service? 2. How many of 60,000 lbs. capacity? 3. Dimensions of the axles used under the above cars. 4. In case you contemplate any change in the above axles, give the dimensions you propose changing to, in red ink. 5. Should you have no cars in service of greater capacity than 40,000 lbs. give the dimensions you recommend for 50,000 lbs. and 60,000 lbs. in red ink.

Replies should be filled in on the back of circular sheet and forwarded to G. W. RHODES, Chairman of the Committee, at Aurora, Illinois, by March 15, 1889.

Engineers' Club of Cincinnati.—At the eighth regular meeting, on Feb. 6, EDWARD FLAD, of St. Louis, was admitted to membership.

Mr. E. J. CARPENTER, who is in charge of the work of dredging done by the Government on the Ohio river, gave a description of the work performed by the two dredges engaged in this service, describing the construction of the dredge boats, which were built under his supervision to special plans prepared by him. The boats are, with the exception of minor parts, made entirely of iron and steeel. Mr. CARPENTER illustrated his lecture by lantern views which served to show more clearly the various kinds of work performed in moving logs, stones, wrecks and bars which form in the channel and obstruct navigation.

J. F. WILSON, *Secretary.*

Engineers' Society of Western Pennsylvania.—The regular meeting of this Pittsburg society was held Feb. 19. Prof. JOHN W. LANGLEY, of the Allegheny Observatory, read a paper on "International Standards for the Analysis of Iron and Steel"; and Mr. H. D. HIBBARD read a paper on "Welding Metals by Electricity," and exhibited samples of welds. A committee was appointed to consider and report upon "The Best Method to Construct and Maintain Public Highways" in the State and recommend legislation relative thereto.

Montana Society of Civil Engineers.—At the meeting at Helena, Mont., Feb. 16, Mr. R. J. WALKER read an interesting paper on the present system of conducting public land surveys, and bore strongly on the inadequate compensation allowed by the existing law for the work done. He suggested that the surveyors be salaried men in the employ of the Government. Messrs. DELACEY, WALKER, and FOSS were appointed a committee to draft a memorial to the next Congress, urging that certain changes be made in the existing system.

National Electric Light Association.—At the meeting held at Chicago, Ill., last week, the following officers were elected for the ensuing year: President, EDWARD R. WEEKS, of Kansas City, Mo.; Vice President, A. J. DECAMO, of Philadelphia, Pa.; Executive Committee: B. RHOADES, Niagara Falls; B. E. SUNNEY, Chicago; GEORGE A. REDMOND, Rochester, N. Y.; C. R. HUNTLEY, Buffalo; OTTO A. MOSES, New York; E. T. LYNCH, New York; P. H. ALEXANDER, Boston; J. F. MORRISON, Baltimore; T. CARPENTER SMITH, Philadelphia.

American Institute of Mining Engineers.—The 53d meeting of the Institute was held in this city last week. Visits were paid to the Edison Electric Works and the works of the Spiral Weld Tube Co., at East Orange, N. J. Among the papers read were: "End Lines and Side Lines," by Prof. R. W. RAYMOND; "The Magnetic Concentration of Iron Ores," by JOHN BIRKINBINE and THOMAS EDISON; "The Application of Electric Accumulators on Storage Batteries in Mining," by P. G. SALOM; "The Brush Plant at Virginia City, Nevada," by N. W. PERRY; and "Steel Rails,—Sections and Specifications," by Capt. R. W. HUNT and Mr. F. A. DELANO.

Rensselaer Society of Engineers.—At the regular meeting at Troy, N. Y., on Feb. 22, the subject of "Foundations for Buildings" was discussed by several members, during which the use of piles for the same was described and criticised. AUGUSTUS S. KIBBE, C. E., of Albany, N. Y., was elected an Associate Member.

B. E. GRANT, *Secretary.*

New York Railway Club.—At the meeting on Feb. 21, the first paper read was on "Car Lighting," describing the system of lighting now being introduced by the Standard Car Lighting Co., of this city. The system consists of incandescent lamps supplied with electricity by the Julien storage battery. In connection with the paper, an excellent exhibit was made of the incandescent lamps, provided with various globes and shades of very artistic design. The light furnished by the lamps was especially brilliant and steady; much more so than is the case with ordinary lamps taking the current from a dynamo.

Mr. EDWARD E. GOLD then read a paper describing the Gold system of car heating with the latest improvements which the company has adopted. As is generally known, the leading feature of this system is the device for storing the heat in a pipe filled with brine enclosed in a second pipe, leaving an annular space through which the steam circulates. Mr. GOLD stated that the difficulty in successful steam heating was not in keeping the cars warm enough, but in keeping a steady and equable temperature. This, he declared, the storage system effected. An incidental advantage is that the cars are kept warm for hours after being detached from the engine, greatly facilitating the operation of cleaning and of drying afterward. A car will remain hot for 6 to 8 hours after being detached from the engine. While most users of steam heat would greatly prefer to have metallic connections between the cars, the preponderance of opinion seems to be that in the present state of the art the best connection is some form of flexible hose. The Gold coupler is now provided with a case-hardened steel gasket, which ensures a tight and durable joint. The company is now prepared to fit up trains with a plant taking steam from the engine to run a dynamo for electric lighting, supply heat to a cooking range for a dining-car or buffet, and also heat the entire train with low-pressure steam taken from the main steam pipe through reducing valves. Pressures of steam usually carried in the Gold heaters are from 10 to 20 lbs.

Mr. BAKER, of the Baker Car Heater Co., then read a paper advocating the use of hot water as a heating medium and discountenancing the use of what he contemptuously described as "raw steam," except for transmitting heat to the hot water. He believed that "raw steam in bare pipes" was unsuited to car warming because it could not give the range and variation of temperature necessary to meet the difficult requirements of the case. Raw steam he also declared to be dangerous in case of accident, and that the pipes containing it gave a bad odor to the air. To meet the demands of perfect safety, the Baker heater as now made is enclosed in a safe of flexible steel, which will bend but never break in the worst smash-up, and will never allow the burning fuel it contains to be scattered.

Mr. R. G. CHASE, of the Williames Car Heating Co., explained the merits of the Williames system of heating. He took the ground that the cardinal difficulty with steam car heating is the obstruction to circulation caused by the accumulation of condensed water in the pipes, and the difficulty in securing tight couplings by reason of the heat and pressure of steam taken directly from the boiler. He depicted in graphic and thrilling terms the inherent weaknesses of traps in every form; the great variations in the heat of different parts of the car, due to the fact that, in order to secure circulation, the heating surface had to be massed at the center of the car, leaving the passengers near the doors to shiver. He told of the wake of condensed water which a steam-heated car left in its rear, and of the icy and dangerous station platforms which this nuisance caused. He described the steam-heated trains on which he had ridden, where 15 lbs. steam in the car next the engine bathed the passengers in a tropical perspiration, while only one pound or so in the rear car gave a temperature far too cold for comfort. The cardinal difficulty was that when pressure was increased for the purpose of forcing the circulation and getting rid of the condensed water, the extra pressure increased the condensation, the remedy applied tending to make the disease worse. To prevent these evils, he prescribed the Williames system, which uses exhaust steam and positively maintains the circulation by a vacuum pump on the engine, connected with return pipes beneath the cars. The system uses 2-in. pipe for both main and return lines and either exhaust or live steam. As the pressure is either less than atmospheric, or but slightly greater, couplings never leak and hose is far more durable. Experiments were described which have recently been made at Altoona, Pa., under the direction of Mr. THEO. N. ELY, Gen. Superintendent of Motive Power of the Pennsylvania Railroad system, which proved that the vacuum pump did effect the removal of condensed water from all parts of the circulating system. A train to be heated by the Williames system is soon to be put on the Pennsylvania Railroad, to run between Philadelphia and New York

A sharp debate followed the reading of this paper, in which the representatives of several other car-heating systems made haste to deny *in toto* the assumptions of Mr. CHASE, that condensed water was an insuperable obstacle to successful steam heating, and that the systems of several other companies did not effect regular, equable, and reliable heating without the aid of any vacuum pump. The discussion over these points waxed so warm that Mr. CHASE finally rose to explain that however sharp the rivalry in a business way between the representatives of the different heating systems, it must be understood that personally they were all the best of friends.

The representative of the Standard Car Heating Co., of Pittsburg, then rose to defend the principles which Mr. CHASE had enunciated, and to approve the Williames system, except in one or two important points where he believed it to be seriously defective. The chief evil in the Williames system, he thought to be the fact that there was an open connection between the heating pipes and the pipes leading to the vacuum pump, which would result, he believed, in pumping the steam out of the pipes before it had done its work. In the Standard Company's system there is an automatic reversing valve connecting the two lines of pipe, so that each line is alternately used as the return line. He described the nuisance caused by the traps of other systems, which discharge the condensed water upon the tracks. One of the officers of the Pennsylvania Railroad had computed the amount of water which steam-heated cars would discharge on the tracks of the Broad St. station if all the cars which run in there were heated by steam. Assuming that the average condensation is one pint per minute, and that the average time which each car remains in the Broad St. station is 10 minutes, he found that 67 barrels of water would be discharged on the tracks of the Broad St. station each 24 hours.

The Erie Car Heating Company's representative then explained that, according to his belief, the one thing needful in a steam-heating system was a steam-tight coupler, and this his company had secured. The copper coil used had proved an unexpectedly durable and perfect device for providing for expansion and motion.

Messrs. MARTIN and MCELROY made some remarks replying to the aspersions which had been cast on their respective systems and various features connected therewith, and the former remarked that the Broad Street or any other station need never have a drop of water spilled on it from steam traps if it was objectionable, as a cock could be turned to stop the drip while it was in the station.

The inventor of the Shackleton system of car-heating stated that he had studied the whole subject of car-heating 20 years ago and had invented and patented the Martin system so long ago that the patent had expired. A long paper was read describing the Shackleton system, which is a combined steam and hot water system. Its cost is $150 to $300 per car.

An animated discussion followed the paper concerning the relative burning effect of high and low pressure steam. Several instances were related in proof of the fact that steam escaping at high pressure felt cold to the hand, and one speaker declared that the reason for the phenomenon was that high-pressure steam escaped from an orifice at such a velocity that it didn't have time to burn.

The testimony seemed to show, on the whole, that there was practically no danger of burning from any steam heating pipe in case of breakage, though there were a good number that held a contrary opinion.

At the President's request, Mr. R. C. BLACKALL (*D. & H. C. Co.*) reported the progress (?) which had been made toward the adoption by the railway companies of a uniform coupler for steam heating The first meeting was held at the Astor House over a year ago; and while no coupler was adopted, it was agreed that none should be adopted except by unanimous consent of all the trunk lines. The date of the second meeting was during the blizzard of Mar. 12, 1888, and for obvious reasons no one attended. At the third meeting, held some weeks later, it was thought best that before any coupler was adopted, the company controlling it should make certain concessions to the railway companies. Such concessions were made by the McElroy Car Heating Co., and their coupler was adopted. Another meeting was held a few weeks later, at which representatives of the New England roads were represented, and the Sewall coupler was adopted; and finally at a still later meeting at which some Western roads were represented, the Martin coupler was adopted.

A railway telegraph signalling apparatus was then exhibited by the inventor. The system comprises a telegraph wire along the whole line of the road, with a box like a city fire-alarm box attached to every fourth or fifth telegraph pole where it can be reached from the ground. Each box has a number and is accurately located on a map in the train dispatcher's office. When a train is stopped at any point between stations for any cause, the conductor can step to one of the boxes and by a code of signals notify the train dispatcher where the train is; and if an accident has occurred, can call for the needed help. Track walkers can also use it to send word to the train dispatcher when they find anything wrong The system has only recently been invented and is not yet patented or on the market.

The club voted thanks to the New England Railroad Club for the invitation to their supper on Mar. 13, and then adjourned.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Baltimore & Ohio.—As noted on our Engineering News page, arrangements have at last been concluded for establishing a through passenger service between New York and Washington in connection with the Bound Brook line of the Reading and the Central of New Jerscy roads.——A bill is before the Senate of Pennsylvania, which proposes to investigate the Schuylkill River East Side corporation, and if possible, annul its charter.

Lehigh Valley.—Brown Bros. & Co. have just taken a bond issue of this company to the amount of $4,000,000. This has been made the basis for a revival of the story that the company intends to build an independent line to Buffalo.

Flint & Pere Marquette.—The arrangements have finally been made for the purchase of the Port Huron & Northwestern road by this company. The purchased road has a main line 91 miles in extent, with 127 miles of branches. The acquisition gives the Flint & Pere Marquette system an extent of nearly 600 miles. The purchased road is 3-ft. gauge, but will be widened to standard immediately, and a large amount of new rail will be laid. The price paid for the purchased road was $2,300,000.

Canadian Pacific.—The open winter is favorable to the work on the London and Windsor extension, and the contractors are already busily engaged on the grading.

Quebec & Lake St. John.—This company is floating an issue of £780,000 five per cent. bonds in London, the interest on which is guaranteed for 10 years by the Provincial Government of Quebec. The line is now in operation from a junction with the Canadian Pacific

railway, 4 miles northwest of Quebec, to Roberval, on Lake St. John, 186 miles. A 12-mile line from St. Ambroise to Quebec is now under construction, and will furnish the company an independent entrance to that city. An extension from Lake St. John to Chicoutimi is also under construction, and a western extension makes a total of 122 miles under construction. Besides this, arrangements are now being made with the Provincial Government for placing under contract an additional section of 25 miles. SIMON PETERS is President, EDWARD A. HOARE is Chief Engineer, and J. G. SCOTT is General Manager. The offices of the company are at 91 St. Peter St., Quebec.

Hartford & Connecticut Western.—This company is before the Connecticut Legislature asking to be allowed to increase its capital stock $2,000,000. Of this $700,000 is to take up existing bonds, $800,000 is to pay the cost of building the extension to Springfield, Mass., and $500,000 is for improvements to the permanent way, bridges, buildings, etc.

Northeast Pennsylvania.—This company owns a road from Abington to Hartsville, Pa., 95 miles in length, which is leased to the Philadelphia & Reading. At a recent meeting of the directors, E. C. KNIGHT, of Philadelphia, was elected President, and it was voted to build an extension from Hartsville to New Hope, on the Delaware river, about 15 miles. The residents along the line of the extension have agreed to take $318,450 of new stock.

Cincinnati, Indianapolis, St. Louis & Chicago.—This company's shops at Cincinnati, O., were burned last week. The loss is about $125,000, half of which is covered by insurance. It is rumored that the shops will be rebuilt at Indianapolis.

Evansville & Richmond.—Right of way has been secured for a belt line at Columbus, Ind. Surveyors are at work between Columbus and Seymour.

Terre Haute & Indianapolis.—President W. R. MCKEEN is said to strongly favor the construction of a union depot at Terre Haute, Ind.

Grand Southern of New Brunswick.—It is reported that the purchasers of this road, RUSSELL SAGE of New York, and others, are to take up the proposed Shore Line railway in Maine and push it to completion.

Toledo, Ann Arbor & North Michigan.—General Manager JAS. ASHLEY is negotiating for the purchase of the Manistee & Northeastern R. R. If he fails to secure it, work will begin at once on the extension to Manistee, and it will be finished by July.

Annapolis & Baltimore Short Line.—This Maryland company contemplates an extension to Bay Ridge, a distance of 4 miles.

Ithaca, Auburn & Western.—An extension to Ithaca, N. Y., 7¼ miles, is under consideration. The road has until recently been operated as part of the Lehigh Valley system. H. D. TITUS, of Auburn, is Superintendent.

Montreal & Sorel.—The members of the Montreal Chamber of Commerce will ask the Government to obtain possession of this road and complete it, as was originally projected, to Point Levis.

New Castle & Shenango Valley.—It is stated that the lease of this Pennsylvania road to the New York, Lake Erie & Western is likely to disturb the relations between the Erie and the Pittsburg & Lake Erie, a Vanderbilt line. The road was built last year to give the manufacturers of the Shenango valley an outlet independent of the Pittsburg & Lake Erie; but that company threatens to make trouble if the Erie breaks its traffic contract and opens the Shenango Valley road for business.

Beech Creek.—An extension about 12 miles in length is to be built in the Clearfield coal region. The road will tap productive coal regions, and it is estimated that it will secure a traffic of 800,000 tons of coal per annum.

Toledo, St. Louis & Kansas City.—This company is marketing a bond issue of $3,500,000, in London. The work on the change of gauge is making rapid progress, and it is expected that the whole line to St. Louis will be standard gauge by April 1.

Projects and Surveys.

Utica & Saratoga.—A project is on foot to build a line of railway from Utica via Dolgeville, Ephratah, Johnstown, and Gloversville to Saratoga, about 70 miles. ALFRED DOLGE, of Dolgeville, N. Y., and GEORGE STREETER, of Johnstown, N. Y., are at the head of the enterprise.

Worcester & Hudson.—We have received the following information from JOHN GILMAN, of Worcester, Mass., President.

The surveys for this road, which is to run from Worcester via Westborough, Marlborough, Sudbury, and Watertown, to Boston, a distance of 44 miles, are to be made soon. There will be considerable rock work on the first three miles of the line from Worcester; the remainder of the route is favorable. About 11 miles of the right of way has been obtained. It is expected that contracts will be let by July 1, 1889, and the road be opened for traffic between South Sudbury and Westborough by the first of December.

A survey is also to be made for a line from East Brookfield via Sturbridge, Brimfield, and Wales to Hartford, Conn., a distance of 45 miles. $30,000 local aid has been secured.

Tiffin & Fremont.—It is stated that contracts for this Ohio road are to be let at once. The road is to run from Marblehead to Upper Sandusky, Ohio. J. G. KANEY, of Toledo, Ohio, is Chief Engineer.

Evansville, Fort Wayne & Chicago.—A press report states that the contract for grading this road has been awarded to a St. Louis construction company and that the road will be built at once from Lafayette to Fort Wayne, Ind., a distance of 108 miles. HARRY DREW of Indianapolis is at the head of the enterprise.

State Line & Oakland.—A correspondent informs us that the engineering corps of this road are at present locating the line through Friendsville, Md. The road is projected to run from Oakland, Md., to Confluence, Pa. The chief engineer is J. U. CRAWFORD, Fox Chase, Philadelphia.

Schenectady & Ogdensburgh.—A bill, which is now before the New York State Legislature, to prevent further encroachments by railroads on the forest preserves of the Northern Adirondacks, will, if it passes, interfere with the construction of the Schenectady & Ogdensburgh R. R., whose route passes through the heart of the North Woods, as well as several other projects which are now on foot. This road was projected to run from Schenectady via Charlton and Northville to Ogdensburgh. JAS. C. JEWETT, of New York, is Vice-President.

Oakland & Phillipsburg.—A project is being revived to build a railway from Oakdale, Ohio, to Phillipsburg, Pa. The road would pass through a newly opened oil region and it is probable that it will be built.

SOUTHERN—Existing Roads.

Florence Northern.—Sub-contractors have already begun work on this road at Florence, Ala.

Atlanta & Florida.—Projects for the extension of this road from Fort Valley, Ga., south, are now being discussed. One proposed route is via Quitman to Jasper, Fla., on the Florida Ry. & Nav. Company's system. Another is via Isabella to Thomasville, Ga. Surveys have also been made for an extension to Brunswick, Ga., and $40,000 bonus and a quarter of a mile of river front have been offered the company if it will build there.

Pensacola & Memphis.—Chief Engineer HUNGERFORD has finished the survey of the Long Creek line.

South Carolina.—It is reported that parties interested in the Charleston, Cincinnati & Chicago Co. will purchase this road, which recently defaulted on the payment of interest on its second mortgage bonds, in order that they may secure a through line to Charleston. The report seems to be a very probable one.

Louisville, Cincinnati & Virginia.—A dispatch from Winchester, Ky., states that grading has been resumed in Estill county on this road. The company began grading many months ago, but nothing has been done since the original start. It is a matter of doubt whether the present resumption of work really signifies that the company intends to build the road. The Kentucky Midland, Kentucky Union, and Louisville Southern are building into this section, and the Louisville, Cincinnati & Virginia perhaps wishes to obstruct the other roads and induce them to buy its franchise.

Savannah, Americus & Montgomery.—Steel rails have been delivered for the extension to Abbeville, and three standard-gauge locomotives have been received. Work on widening the gauge is making rapid progress.

Georgia Pacific.—Construction trains are now running from Greenville, Miss., east to the Yazoo river, and passenger trains are to begin running very soon. On the extension from Columbus, west, tracklaying is making rapid progress.

Kanawha & Ohio.—The Mercantile Trust Co. of this city has brought suit for the appointment of a Receiver for this company. Judge HOWELL JACKSON appointed President ROBERT W. KELLEY, Receiver.

Cape Fear & Yadkin Valley.—Supt. J. W. FRY, and Chief Engineer ROGER P. ATKINSON are making arrangements for the terminals at Wilmington, and will receive bids at once for the erection of wharves and warehouses at that point.

Nashville & Knoxville.—It is proposed that the citizens of Knoxville, Tenn., extend aid to this company so that it can push work at once on its extension from Carthage, east. The Knoxville *Tribune* suggests that the subscription which was voted to the bankrupt Carolina, Knoxville & Western might be now transferred to this company.

Savannah & Tybee.—It is stated that Receiver H. MYERS will lay part of this road with new 50-lb. steel rails.

Kentucky Midland.—This company has filed a mortgage to the Central Trust Co. of New York City to secure bonds to the amount of $5,000,000, being at the rate of $25,000 per mile for the 200 miles of the road between Frankfort and the Virginia State line.

Knoxville, Cumberland Gap & Louisville.—About 20 miles of track have been laid on this road from Knoxville north.

Cincinnati Southern.—This company has had two severe experiences with fire of late. Just after the fire in Tunnel 17, near Sunbright, Tenn., came the fire in the "Big Four" shops at Cincinnati, directly under one of the shore spans of the Cincinnati Southern bridge. It is stated, however, that little damage was done to the structure.——The Ohio Legislature has passed a bill authorizing the trustees to lease the property for 40 years from the end of the present lease at an annual rental of $1,250,000. The present lease has 17 years to run.

Projects and Surveys.

Chattanooga & Evansville.—A company has been organized, with L. M. RICE, of Evansville, Ind., as President, to build a railway from Chattanooga, Tenn., to Evansville, Ind., through the counties of Hamilton Grundy, Warren, DeKalb and Sumner, a distance of about 275 miles.

Nashville & Charleston.—According to a press report, the Chief Engineer of this road believes that the prospects for its early construction are very good. The road was projected to run from Nashville, Tenn., to Charleston, S. C., a distance of 590 miles. A preliminary survey of the whole line has been made and a distance of about 75 miles has been located. W. L. BREYFOGLE, of Louisville, Ky., is President and WM. H. CASE, of Knoxville, Tenn., is Chief Engineer.

Cincinnati, Huntsville & Birmingham.—It is stated that capital has been secured for the construction of this line, and that work will begin at Huntsville, Ala., within two months, and the road be completed to Tullahoma, Tenn., by March 1, 1890. Huntsville and Madison county will subscribe $40,000 in stock and give right of way and terminal facilities. The road was projected to run from Somerset, Ky., to Birmingham, Ala., a distance of 350 miles. M. R. CAMPBELL, of Tullahoma, Tenn., is President.

Sheffield & Seaboard.—The Alabama Legislature has passed a bill to ratify the charter of this road, in which some defect was found, and to appropriate $19,000 for further surveys. It is stated that work will begin very soon on the division between Sheffield, Ala., and Aberdeen, Miss., a distance of 95 miles, and that it will be finished as soon as possible. A. H. MOSES, of Sheffield, Ala., is President of the company.

Alabama.—Bills have been introduced in the Alabama Legislature incorporating the Gulf & Chicago R. R. Co. and the Mobile & Eastern Shore R. R. & Nav. Co.

Norcross & Cumming.—It is reported that a railroad is projected to be built from Norcross, Ga., to Cumming, Ga., a distance of about 17 miles.

Fayetteville & Albemarle.—A bill is before the North Carolina Legislature incorporating the Fayetteville & Albemarle R. R. Co.

St. Augustine, Pablo Beach, Mayport & Jacksonville. GEORGE W. GIBBS, S. T. FOX, and others, of Florida, have incorporated the St. Augustine, Pablo Beach, Mayport & Jacksonville R. R. Co.

South Carolina.—It is stated that a company is to be organized to build a line of railway from D. A. DICKERT's stone quarries to the Spartanburg, Union & Columbia R. R. W. C. WHITNER has already made the surveys and the estimated cost is about $25,000.

THE NORTHWEST—Existing Roads.

Northern Pacific & Manitoba.—A modified contract has been made between this company and the Provincial Government of Manitoba, under which the Province pays to the railway company a cash bonus of $633,000. This contract meets with almost unanimous approval in the Provincial Parliament.

Canadian Pacific.—The negotiations have finally been closed for the transfer of the Regina & Long Lake railway to this company. Work will begin early in the spring on the extension to Edmonton via Saskatoon. A branch will probably be built from Saskatoon to Prince Albert, N. W. T.

Burlington, Cedar Rapids & Northern.—There is a rumor that the company intends to build a branch in the spring from Rockford to Mason City, Ia., about 5 miles.

St. Louis & Chicago.—The American Loan & Trust Co. has applied for a Receiver for this Illinois road, and Judge GRESHAM has appointed T. J. CAVATT, of Litchfield, Ill. It is charged that D. L. WING, the former President of the railway, has fraudulently transferred property of the company to another corporation.

Chicago, St. Paul & Kansas City.—The American Loan & Trust Company of New York has brought suit against the Chicago, Freeport & St. Paul Railroad Company and others. This road is better known as the "Freeport Line." In March, 1884, a mortgage was executed on the "Freeport Line" and bonds for $10,000,000 were issued.

The American Loan & Trust Company was the Trustee, and it now files a bill to foreclose the mortgage. The railway never was constructed, and its right of way for 18 miles between Maywood, Cook County, and St. Charles, on the Fox river, in Kane County, the roadbed of the old St. Charles Line, is now held by the Chicago, St. Paul & Kansas City Railroad Company.

The complaining trust company says that the "Freeport Line" will not bring suit to recover the land to which it has a title, and the trust company therefore asks that it be subrogated to all the rights of the "Freeport Line" in the contracts, including the right to compensation by reason of the fraudulent usurpation by the Minnesota Line. In the foreclosure it is prayed that the 18 miles of line may be included, and a Receiver and an injunction are asked for.

Chicago, Milwaukee & St. Paul.—The company has issued the following preliminary statement for 1888: Gross earnings, $24,867,730.56; net income for the year,

$7,708,551.08; surplus for the year, $119,302.34; the decrease in gross earnings was $498,393.42; the increase in operating expenses, $2,050,659.59, and the increase in interest on indebtedness, $592,339.11.

Northern Pacific.—A story has been widely circulated of late that the company is interested in certain railway projects now asking charters of the Quebec Parliament, and intended through them to secure a through line to the Atlantic seaboard. Also that it intended to make a sharp fight to regain the tea carrying trade from the Pacific coast east; and was to run a telegraph company in Manitoba in opposition to that now run by the Canadian Pacific. In an interview with a reporter of the St. Paul *Pioneer Press*, President OAKES stated that all these stories were pure fiction, as is also the oft repeated statement that a consolidation of the company with the Wisconsin Central is soon to be effected. In reference to the tea trade, he said the Northern Pacific carried last year double the tonnage of tea that it had carried in any previous year. Negotiations are in progress for the transfer of the lines of emigrant sleeping cars now run over the road to the Pullman company and will probably be successful.

St. Paul, Minneapolis & Manitoba.—A bill has passed Congress and received the President's approval, granting the company right of way through the White Earth Indian Reservation in Minnesota.

Indianapolis, Decatur & Western.—It is announced that grading is to begin as soon as the weather will permit on the extension from Decatur, Ill., west. Surveys are completed from Decatur to Petersburg, on the Chicago & Alton. The country is very favorable for construction, and the line is very direct, having one tangent 20 miles in length.

Duluth & Winnipeg.—The fight over the bill to forfeit to the State school fund the swamp lands claimed by this company is now occupying the attention of the Minnesota Legislature. We are informed that it is quite probable that a portion at least of the road will be built, whether the company secures the land grant or not.

Evansville & Terre Haute.—The announcement last week that D. J. MACKEY, the head of this system, has secured control of the Illinois & St. Louis, and the Louisville, Evansville & St. Louis railroads, is fully confirmed. Mr. MACKEY states that work will begin as soon as possible on the connecting link to run from Mt. Vernon to Belleville, which will give the company an independent line from Louisville to St. Louis. It is part of the plan to enter St. Louis over the new Merchants' Bridge.

Chicago, St. Louis & Paducah.—The following are the officers of this company: W. K. MURPHY, President GEO. W. PARKER, General Manager; H. T. NASH, Auditor, and E. F. LEONARD, Secretary. It is proposed to extend the line north to Centralia and to further the building of extensions from Paducah, Ky., south. The road is a part of the St. Louis, Alton & Terre Haute system.

Projects and Surveys.

Duluth & Superior Belt Line.—Incorporated in Minnesota to build a line of railway from a point on the extreme southern end of Rice's Point, near Duluth, along Superior bay and southeast to a point on the southern extremity of Minnesota Point; also to purchase, build, and operate all transfer boats and bridges necessary to operate the above belt line. C. M. VANCE, of Duluth, is President, and ELIJAH C. GRIDLEY, of Duluth, is General Manager.

Kankakee & Northern.—Incorporated in Illinois to build a line of railway from Kankakee, Ill., to Harrington, Ill. Among the incorporators are CHARLES DENEHY, C. E. RALLINGS, CORNELIUS RYAN, and J. N. SUMMERS, all of Chicago. The principal offices will be at Chicago.

Kootenai & Athabasca.—This company seeks a charter from the Canadian Parliament, to build a railway from Ravelstoke, B. C., to the International boundary. Among the projectors are MCLEOD STUART, of Ottawa, C. W. MOBERLY, and J. ISBERTER. The capital stock is $1,000,000.

Duluth, Crookston & Northern.—Organized in Minnesota to build a line of railway from Crookston to a point on the Duluth & Winnipeg. Among the projectors are JOHN LOCKEN, E. M. WALSH and JOHN MCLEAN.

Sioux City & Northern.—The Board of Directors of this company resolved, at a recent meeting, to release the 8 per cent. tax voted in aid of the road by Sioux City, Ia. This step is said to be due to the fact that other arrangements have been made for building the road. The present plan is to use the tracks of the Illinois Central for 18 miles out of Sioux City, and to build from this point to Palisades, Dak., and a connection with the St. Paul, Minneapolis & Manitoba.

THE SOUTHWEST—Existing Roads

Missouri Pacific.—It is stated that a line will be built this year from Larned to McCracken, Kan., about 20 miles.——The New York *Sun* published a long article recently, calling on stockholders of the company to demand a report by the managers before they give them their proxies for use at the annual meeting to be held on March 12, and also requesting to know what officers the present solicitors of proxies propose to elect.——It is reported that "Bad Boy EDDIE GOULD" is to succeed AMOS HOPKINS as a Vice-President of the company.

Cleveland, St. Louis & Kansas City.—A force of 60 hands is working on the grading at Augusta, Mo., under contractor Coffey. President T. C. CLARKE, and contractors T. M. BAIRD of Pittsburg and J. E. WILLARD of Chicago are on the ground and are pushing the work as fast as possible.

Missouri, Kansas & Texas.—Receiver CROSS is in favor of completing the Dallas & Waco extension to Waxahachie, Tex. Work is soon to begin on new depot buildings at Dallas.

Paris, Marshall & Sabine Pass.—A subscription of $40,000 is being raised at Marshall, Tex., in aid of this company; and it is expected to locate the company's machine shops at that place.

Projects and Surveys.

Dallas, Pacific & Southeastern.—Incorporated in Texas to build a line of railway from New Orleans northwest to Dallas, and through the counties of Wise and Jack to the Pacific coast. This company is a successor to the Dallas, Archer & Pacific, the charter, right of way, etc., of which they purchased, for $8,000, about two months ago, which line was projected to run from Dallas through Clay, Jack, and Archer counties. It is stated that $125,000 has been raised by private subscription. With this and a subsidy of $50,000 which is asked, it is promised that the first 100 miles of the road will be constructed and in operation by Oct. 1, 1889. Surveyors are now at work locating the line. The officers of the company are J. E. HENDERSON, President; H. M. MCLAURIN, Vice-President; W. H. FLIPPEN, Treasurer, and J. P. MURPHY, Secretary.

Gatesville & Temple.—A project is being agitated by the citizens of Gatesville, Coryell county, Tex., to build a line of railway from that place to Temple, a distance of 40 miles.

Fort Worth & Albuquerque.—Incorporated in Texas by MAX ELSER, M. H. MCLAURIN and others, the Fort Worth & Albuquerque R. R. Co. with a capital stock of $1,000,000.

Texas Grand Trunk.—It is stated that this company has secured the necessary capital to construct its line. The road with its several branches will pass through the counties of San Augustine, Nacogdoches, Houston, Burnett, Baudera, Zavalla and McLennan, a distance of 750 miles. The officers are: THOS. H. WILSON, of New York, President and CHARLES R. EVANS, of New York, Secretary and Treasurer.

ROCKY MT. AND PAC.—Existing Roads.

Gilman & Gold Belt.—President JOHN GILMAN, of Worcester, Mass., writes us that grading is about half done on the first 5 miles of this Idaho road, and that ties and rails are on the ground. It is expected to complete the line this summer to the Gold Belt mines, a distance of 14 miles.

Denver, Texas & Fort Worth.—It is stated that a branch will be built this season from Trinidad, Col., to Las Vegas, N. M.

Denver & Rio Grande.—About 1,200 men are now at work on the extensions to Lake City and Rifle Creek under contractors Scullin & Stacy and McMurtrie & Streeter. Both lines will be finished by July. The new extensions are to be bonded at the rate of $20,000 per mile. It is believed that either this company or the Colorado Midland will build to a connection with the Denver & Rio Grande Western at Grand Junction.

Union Pacific.—The board of directors of this company and of the Northern Pacific have closed what is described by a Northern Pacific director as an "arbitration contract, which means an agreement to operate all their lines together jointly, and for joint benefits. It is an agreement for harmony instead of war and rivalry."

The control of all competitive lines in eastern Washington Territory and Oregon, is to be placed in the hands of a board of 5 managers who are to operate them for the joint benefit of the two corporations. The same benefits will be secured that would have been gained by a joint lease of the Oregon Railway & Navigation Co., and without the obligation to guarantee returns on the securities of that company.

Northern Pacific.—The Board of Trade of Butte City has voted to have surveys made for the proposed extension of the Northern Pacific to Butte via Pipestone Pass. If a feasible route can be secured, steps will be taken to induce the company to undertake the extension.

Oregon & Washington Territory.—Chief Engineer FRANK RIFFLE has completed plans for a 20-stall engine house and for repair shops, which will be put up at Walla Walla this season.

Ilwaco & North Beach.—Tracklaying has begun on the extension of this Washington Territory road.

Astoria & South Coast.—Chief Engineer HENRY B. THIELSEN has let contracts for clearing and grading 10 miles of this road, from Skipanon south.

Vancouver, Klickitat & Yakima.—Grading is making fair progress on the second division of this road. The contractors are greatly favored by the mild winter.

Southern Pacific.—The company has issued its annual report, giving the following as results of operations in the entire system:

Gross earnings	$48,853,208
Operating expenses, taxes and interest	44,901,381
Rental of Central Pacific	1,360,000
Net surplus	2,588,826

The net surplus in 1887 was only $1,306,700, the gross earnings being $39,283,331, and the expenditures $36,716,630.

Atlantic & Pacific.—Grading is in progress for the line which is to reach the new bridge across the Colorado river, now under construction, the site of which was illustrated in the last issue of ENGINEERING NEWS.

Projects and Surveys.

Colorado & Pacific.—Incorporated in Colorado to build a line of railway from Trinidad, Colo., through the States of Colorado, New Mexico, Arizona and California to San Francisco. Surveyors are reported to be in the field and grading will begin early in the Spring. Among the incorporators are GEO. M. DUNN, of Denver, and E. D. WRIGHT and C. BARELA, of Trinidad.

Spokane Falls & Northern.—The $100,000 worth of stock asked by this company of Spokane Falls has been subscribed, and it is stated that construction will begin at once. The road is to run from Spokane Falls via Colville to Little Dalles on the upper Columbia.——A railway from Spokane Falls to Colfax, a distance of 100 miles, is talked of in connection with the Spokane Falls & Northern.

Fresno, Belmont & Yosemite.—It is reported that construction will commence on the eastern extension of this road within 30 days. The road is to run from Fresno east into the Sierras a distance of about 60 miles, and it is expected to have it in operation in about a year.

Petaluma, Sebastapol & Russian River.—A company has been organized in California to build a road with the above name. The residents of Petaluma are especially interested in the enterprise.

RAPID TRANSIT.

Cable Railways.—*Pittsburg, Pa.*—The Central Traction Ry. Co. has awarded the contract for the construction of its line to Booth & Flinn for $283,000. This includes the concrete and iron work of the track, and a sub-contract will be let for the iron work. Contracts for buildings and machinery will not be awarded for some weeks. The line is expected to be in operation by next autumn.

Kansas City, Mo.—The plans for the single-track loop cable line have been submitted to City Engineer DONNELLY for approval.

Electric Railways.—*Portland, Me.*—The Portland Street Ry. Co. proposes to put in an electric system during the year. Negotiations are pending with the Thomson-Houston and Sprague companies.

Elizabeth, N. J.—The Union & Essex Electric Street Ry. Co. has been organized and has applied for a franchise.

Roanoke, Va.—The Roanoke Electric Street Ry. Co. will begin tracklaying soon. The ties for 4 miles of line are being distributed along the route. The line will run to Salem, 10 miles, and there will be about 10 miles more on the city streets.

Indianapolis, Ind.—The Citizens' Railway Co. proposes to adopt an electric system on its line.

Chattanooga, Tenn.—Mr. W. K. BURTON, who is interested in the projected line to Chicamauga, wants information in regard to different systems of electric traction.

Nashville, Tenn.—The City Electric Ry. Co. has been organized. Capital stock, $40,000. President, I. T. RHEA Vice President, JAMES H. BRUCE; Secretary, SANFORD DUNCAN.

Armourdale, Kan.—Work will shortly be commenced for putting up the wires for the electric railway.

Laredo, Tex.—The Laredo Improvement Co. has decided to operate its street railway line by electricity and is negotiating with some electric power companies.

Street Railways.—*Lansingburg, N. Y.*—The Lansingburg Ry. Co. has been organized to build a rapid transit line to Troy, a distance of 6 miles.

Stanford, Ky.—A street railway is to be built to Rowland. Mr. J. C. RODEMER is interested.

Jeffersonville, Ky.—The Ohio Falls Street Ry. Co. opened bids March 1 for the construction of the first section of its line. Work will be commenced soon.

Troy, Ala.—The Alabama Land & Improvement Co. proposes to build a street railway.

Beatrice, Neb.—The South Beatrice Street Ry. Co. has purchased rails, ties, and cars. Work will be commenced as soon as the weather will permit.

Whatcom, Wash. Ty.—The Bellingham Bay Street Ry. Co. has been organized by D. R. HUNTOON, P. D. MCKILLAR, and JONES GISE. Capital stock, $125,000. Work is to be commenced within 60 days from date of franchise.

Olympia, Wash. Ty.—The Olympia & Tumwater Railway, Light & Power Co. will build a street railway. Capital stock, $250,000. G. D. SHANNON, of Olympia, and A. M. STEWART, of Tacoma, are interested.

Jonesboro, Ark.—The Jonesboro Street Ry. Co. wants rails and cars for a line ¾ mile long. Address O. M. WILSON.

Stuttgart, Ark.—The street railway company expects to build its line next summer. Address T. H. LESLIE.

Chapel Hill, Tex.—It is proposed to build a street railway from the town to the railway station.

CONTRACTING.

Stone.—The following proposals for furnishing and depositing stone on the jetties at Charleston were opened Feb. 16 by Capt. F. V. ABBOT, U. S. Engineer Office, Charleston, S. C.: Anson M. Bangs, Fayetteville, N. Y.: $2.54 per short ton for 25,000 tons at outer end of north jetty, $3.43 per ton for 5,000 tons at shore end of south jetty, $2 per ton for 20,000 tons in main ship channel, $2.54 per ton for 50,000 tons on outer portion of south jetty; total, $247,650. C. M. Grant and G. W. Egan, Charleston, S. C.: $2.49, $2.79, $2.47, $2.45; $248,100. Thomas Young, Charleston, S. C.: $2.60, $3, $2.50, $2.60; $260,000. W. F. McCauley, Savannah, Ga.: $2.88, $2.97, $2.27, $2.88; $276,250. Southern Construction & Quarry Co., Nashville, Tenn.: $2.90, $2.98, $2.79, $2.83, $2.84; $583,700. All the bids were rejected as being too high, the appropriation being $195,000. Further bids were asked for informally, but were subsequently countermanded, and the work will probably be readvertised.

Lock Pit.—The following proposals for constructing a lock pit at the St. Mary's Falls canal, Michigan, were opened Feb. 18 by Col. O. M. POE, U. S. Engineer Office, Detroit, Mich.:——Collier & Farwell, Detroit, Mich.: excavating and removing 131,000 cu. yds. of earth, 43 cts. per cu. yd., bank measure; excavating and removing 108,000 cu. yds. of rock, 33 cts. per cu. yd., bank measure; 100,000 cu. yds. of filling in front of Fort Brady, 13 cts. per cu. yd., placed; piling 5,000 cu. yds. of stone on canal pier, 75 cts. per cu. yd.; building 1,000 cu. yds. of retaining wall and paved drains, $3.95 per cu. yd.; total, $220,670. ——John Hickler & Son, Sault Ste. Marie, Mich.: earth and rock excavation, 47 and 49 cts.; filling, 26 cts.; stone, 75 cts.; retaining wall, $3.70; total, $255,940.——Hughes Bros., Syracuse, N. Y.: earth and rock excavation, 89 cts. and $1.09; filling, 30 cts.; stone, 50 cts.; retaining wall, $3.06; total, $269,870.——Carkin, Stickney & Cram, East Saginaw, Mich.: earth and rock excavation, 80 cts. and $2.50; filling, 30 cts.; stone, $2; retaining wall, $1; total $415,800.

PROPOSALS OPEN.

Street Work.—Grading, repairing and repaving; gutters, drains, etc. LOUIS WAGNER, Director of Public Works, Philadelphia, Pa. March 4.

Water-Works.—THE CITY CLERK, Seymour, Ind. March 5.

Railway.—About 25 miles of the Savannah, Americus & Montgomery Ry. R. A. HARDAWAY, Chief Engineer, Americus, Ga. March 5.

Pier Work.—Dumping board on the pier at W. 12th St. North river. THE COMMISSIONER OF STREET CLEANING, 49-51 Chambers St., New York City. March 8.

Bridges.—Wrought iron bridge; also wrought iron bridge and trestle. Plans and specifications on file. FRANK J. O'FLAHERTY, County Surveyor, Water-Works Building, Kansas City, Mo. March 11.

Street Work.—Macadamizing and grading. Specifications on file. FRANK J. O'FLAHERTY, County Surveyor, Water-Works Building, Kansas City, Mo. March 11.

Timber.—Sawed yellow pine. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. March 13.

New Croton Aqueduct.—Clearing and removing all timber, brush, grass, and other vegetable growth from the lands that are required for the East Branch reservoir, on the east branch of the Croton river and on Bog brook, in the town of South East, Putnam County, N. Y. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. March 13.

Bridge.—Wooden highway bridge and approaches over the Chelan river; river span 80 ft., approaches 166 ft., roadway 16 ft. wide. C. B. BASH, County Auditor, Conconully, Okanogan Co., Wash. Ty. March 15.

MANUFACTURING & TECHNICAL.

Railway Supplies.—The Phœnix Railway Supply Co. has been incorporated: President, L. F. VOORHEES; Secretary, F. M. VOORHEES; General Manager, E. H. VAN FLEET. Office, 15 Cortlandt St., N. Y.

Rock Drills.—The Cummings Rock Drill Co. has been organized by CHAS. CUMMINGS and W. B. LAKE, of Oakland, Cal., and D. C. NICHOLS, E. BRIGGS and GEORGE T. EMERY, of San Francisco, Cal. Capital stock, $600,000.

The Molten Metal Centrifugal Decomposing Co. has been organized at Chicago, Ill., by J. O. HUDNUTT, T. A. BANNING and J. W. DRYENFORTH, with a capital stock of $1,000,000, for the treatment of molten metals by a centrifugal process, the decomposing of metallic salts, and the desulphurizing of ores in a molten state.

Construction Companies.—At Denver, Col., the Denver Contractors' Association has been organized for the purpose of constructing cable and other railways, and operating the same. Capital stock, $1,000,000. Incorporators, GEO. W. BRIGGS, CHARLES F. MUSGROVE, CHARLES K. DURBIN, FRANK EVANS and HENRY C. BAUM.

At Montgomery, Ala., the Western Contract & Construction Co. is to be incorporated by a charter from the Legislature.

Steel Castings.—The Florida Iron Works, of Apopka, Fla., wants quotations at once on light steel castings, steel wire and cold rolled steel suitable for ties; also light drop forgings.

The Cumberland Cement Works, of Cumberland, Md., have put in new machinery to increase the capacity to 500 bls. per day.

Steel Works, Etc.—Basic steel works are to be established at Sheffield, Ala., by a company in which JACOB REESE, of Pittsburg, Pa., is interested.

The Redemann-Tilford Co., of Louisville, Ky., has recently received patents upon a new process for converting soft steel into the highest grade of the metal, and are considering plans for the establishment of works to put the process into practical operation.

The Winona Foundry Co. has been incorporated at Winona, Minn., with a capital stock of $25,000. President, JOHN STELLWAGEN; Secretary, H. J. COLE.

Garbage Crematory.—The Eagle Cremation Co. proposes to erect a garbage crematory for the city at Jacksonville, Fla. W. F. MORSE is the agent.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 2 ten-wheel freight engines to the Kansas City, Wyandotte & Northwestern, and are building 2 more for the same road. The works have delivered 2 engines to the Buffalo Creek road and are building 3 for the Vicksburg & Meridian.

The Schenectady Locomotive Works, of Schenectady, N. Y., have completed 3 passenger engines for the Cleveland, Columbus, Cincinnati & Columbus, 7 engines for the Duluth & Iron Range, 8 twelve-wheel engines for the Central Pacific, and some engines for the Charleston, Cincinnati & Chicago. Further orders from the last two roads are now in hand.

The Rhode Island Locomotive Works, of Providence, R. I., are building 12 engines for the Kings County Elevated road, in Brooklyn, N. Y.

The N. Y. Central & Hudson River has completed 6 switch engines, with swallow-tailed tenders, at the West Albany shops.

The Chesapeake & Ohio has ordered 4 heavy passenger engines for the vestibule train which is to be put on in May.

Railway Material.—Mauldin & Son, of Hampton C. H., S. C., will build a standard-gauge logging road 7 to 10 miles long.

Harold Bros. & Scott, of Brewton, Ala., will build a logging road 5 miles long.

The Jonesboro Street Ry. Co., of Jonesboro, Ark., wants iron or steel rails and 2 one-horse cars, new or second-hand. The line will be ¾ miles long.

Pressure Regulators.—The Foster steam pressure regulator is being applied to locomotives by the Pennsylvania and the Philadelphia, Wilmington & Baltimore roads; also by the Baldwin Locomotive Works. Testimonials have recently been received from the Long Island Brewery, of Brooklyn, and E. J. WOOD, Consulting Engineer, of New York. A 10-in. pressure regulator has been supplied to the water-works at Cincinnati, O., and another to the water-works at Asheville, N. C.

Filter.—The County Commissioners of Wauwatosa Co. at Milwaukee, Wis., have purchased a filter from the Jewell Pure Water Co., of New York. Its capacity is about 1,000,000 galls. per day.

Signals.—The Johnson Railroad Signal Co., of Rahway, N. J., has orders on hand from the New York Central, Pennsylvania, Erie, and Kings County Elevated railways. The works are being enlarged.

The King Automatic Railway Signal Machine Co. has been organized at Greenville, S. C., by Mr. H. O. KING and others, with a capital stock of $1,000, which is to be increased.

A company is being organized at Lexington, Va., to manufacture the railway signal invented by Mr. W. H. WADDELL, of that city. For particulars address Mr. G. D. LETCHER.

Snow Plough.—A rotary snow plough has been sent out to clear the Gunnison branch of the Union Pacific. This is a narrow-gauge line and is said to be covered with snow-drifts from 3 to 8 ft. deep.

Hydrants.—In the Adams patent improved fire hydrant, manufactured by the Tamaqua Mfg. Co., of Tamaqua, Pa., all the working parts are easily removable. A brass jam nut at the top of the cap holds all the working parts in place and makes the water-tight joint between the valve and elbow. The valve stem is made tapering so that when screwed down to open the valve it keeps the drip-valve tight while the hydrant is in use; a brass spiral spring opens the valve when the hydrant is closed, so as to allow the water in the stand to pass out. In a double-nozzle hydrant the internal diameter at the bottom is 8 ins. and at the nozzle 7 ins.; the large internal area, which is necessary to enable the working parts to be removed and replaced without digging up the stand-pipe, serves as a reservoir, and the tapering form of the stand-pipe prevents heaving by frost. The working parts in a 5 ft. 6 ins. double-nozzle hydrant weigh 55 lbs., and can be lifted out and replaced by one man.

Street Sweepers and Roller.—The Contracting Board, at Troy, N. Y., has been authorized to purchase one or more street-sweeping machines; the cost is estimated at about $300 to $400 each.

The City Engineer of Winnipeg, Man., has been directed to examine several sweeping machines at Chicago, Ill., with a view to deciding on a suitable one for the city purchase.

The Board of Public Works, Knoxville, Tenn., proposes to purchase a steam roller for putting the macadamized streets in good condition.

Ditching Machine.—L. S. LEVERSEDGE, of Dallas, Tex., wants a machine for digging 3 x 2 ft. ditches in prairie lands.

Car Notes.—The Laconia Car Co., of Laconia, N. H., is building 10 passenger cars for the Boston & Maine.

The Erie Car Works, of Erie, Pa., are building 150 platform cars for the Sinnamahoning road.

The Jackson & Sharp Co., of Wilmington, Del., has built several passenger cars for the Charleston, Cincinnati & Chicago.

The Ohio Falls Car Works, of Jeffersonville, Ky., are shipping 15 cars per day to the Pennsylvania.

The Elliot Car Works, of Gadsden, Ala., have an order for 700 freight cars for the Cincinnati, New Orleans & Texas Pacific.

The Haskell & Barker Car Co., of Michigan City, Ind., is building 270 ore cars for the Duluth & Iron Range.

The Pullman Palace Car Co., of Pullman, Ill., is building an officers' car for the Duluth & Iron Range.

The Richmond & Danville will add 200 freight cars to its equipment.

BRIDGES AND CANALS.

Canal.—The St. Augustine & St. John's Canal Co. is to be organized at St. Augustine, Fla., to build a canal from the St. John's river to St. Augustine if the bar is made navigable for ocean steamers. The estimated cost is $30,000.

Bridge Notes.—***Providence, R. I.***—The City Engineer has submitted estimates for the public bridges for the year: Point Street, Central and Washington bridges, $1,000 each; Manton bridge, one-half, $2,000; Hawkins St. $700; tools, $700; all other bridges $1,098.75; Exchange bridge $5,000; Washington bridge over Providence river, repairs, $5,000; total, $17,498.75; salaries $7,001.25. No estimate for rebuilding Washington and Exchange bridges is submitted because of the uncertainty as to charges in channel in connection with new facilities.

Cornwall, N. Y.—The West Shore R. R. Co. will build a drawbridge across Moodna creek in accordance with the requirements of the Secretary of War.

Avondale, N. J.—The new Passaic river bridge has been opened. The bridge is 360 ft. long, and has 2 fixed spans of 90 ft. in length and a draw span of 165 ft. It cost $26,000. One-half of the expense will be borne by each county. The mason work was done by A. R. Morrison, of Wilmington, Del., and the iron work by the Smith Bridge Co., of Toledo, O.

Corrigansville, Md.—Messrs. Logsdon & Nick propose to build a bridge across Wills creek.

Wheeling, W. Va.—It is proposed to build a bridge from Wheeling to the island and from the island to Etnaville, at an estimated cost of $300,000.

Knoxville, Tenn.—A number of bridges across the creek are projected.

Montgomery, Ala.—A bill has been introduced in the Legislature to authorize the issuing of bonds to build a bridge over the Alabama river at or near Montgomery.

Gadsden, Ala.—It is proposed to build a bridge at a cost of $50,000.

Detroit, Mich.—The Michigan Central Railroad has sent to the Board of Public Works for approval, the plans of the new iron bridge it proposes to put over its Fort St. west crossing. The bridge, as planned, is a one-span structure; it is 91 ft. long, the full width of the street. Its estimated cost is $10,000.

Grand Rapids, Wis.—The contract for the Wisconsin river bridge has been awarded to the Milwaukee Bridge & Iron Works for $17,400. There will be two spans of 250 ft., with 18 ft. roadway and two 5-ft. sidewalks.

St. Paul, Minn.—The contract for the Minnehaha St bridge has been awarded to J. C. Turk, of Minneapolis, (agent for the Pittsburg Bridge Co.) for $19,508.

Burlington, Ia.—The city has appropriated $1,500 towards the cost of a bridge over Flint creek; 120 ft. span, 18 ft. roadway.

Grand Forks, Dak.—Van Norman & Lambert, of Minneapolis, Minn., have contracts for the substructure of two bridges over the Red river for $39,242.

ELECTRICAL.

Electric Lighting.—***Washington, D. C.***—The Washington Electric Light Co. has been organized, with a capital stock of $1,000,000, to put in a Thomson-Houston system. B. H. WARNER and A. T. BRITTON, of the Columbia National Bank, are interested.

Chester, S. C.—An electric light system is contemplated. For particulars address the mayor.

Rome, Ga.—The City Council has decided to make a contract with the electric light company for 3 years. The prices are to be $10 per month for all arc lights of 2,000 c. p., $5 and $2.50 per month for incandescent lights of 16

c. p. and 32 c. p. respectively. The lights are to be in operation by June and are to burn all night.

Fernandina, Fla.—Propositions for establishing an electric light plant are wanted by R. S. SCHUYLER.

Columbus, Ind.—The City Council has made a contract for one year with the Citizens' Electric Light Co. at $52 per light for 50 lights.

Cadillac, Mich.—The Commer Electric Light Co. has put in a Thomson-Houston plant with a capacity of 60 arc lights and 600 incandescent lights. The company has purchased the Waterhouse plant and now operates both systems.

St. Charles, Mo.—An electric light company wants to locate a plant here without a franchise from the city, being willing to run the risk of patronage.

Sedalia, Mo.—The City Council received five bids in answer to the advertisement for proposals for electric lighting, and awarded the contract to the Sedalia Electric Light Co. for $87.50 per light per year for 100 arc lights. JAMES GREEN and L. N. RUMSEY, of St. Louis, have applied for a franchise and propose to establish a competing plant.

Fort Scott, Ark.—The Fort Scott Electric Light Co. has made a bid for a two years' contract, with the privilege of five years; not less than 50 arc lights, at $15 per month for two years, at $12.50 per month for all required over that number, or $10 per month for not less than 50 lights and $9 for all over that number, on a five years' contract.

Green River, Wyo.—An electric light plant is contemplated, to be operated in connection with the waterworks.

Eureka, Cal.—The Eureka Electric Light Co. has just put in a Brush plant, with 3 dynamos of 30 lights capacity driven by two 65 H. P. engines with two boilers.

Winnipeg, Man.—The Lighting Committee will advertise for proposals for the electric lighting of the city at a rate per light per night for arc and incandescent lights respectively; for 50 lights or more of the arc system, to be not less than 2,000 c. p. or its equivalent in number and lighting capacity of the incandescent system, contract to run for three years.

The Advance Electric Co. has been organized, and has opened offices at 17 Broadway, New York. The company owns the "Advance" system for power and lighting.

Electric Conduits at St. Louis.—Mayor ALLEN has signed the ordinance granting the National Subway Co. the right to lay conduits for electric wires underground. The company will build them on the Dorsett system. Work will be commenced in March. A bill is now before the State Legislature to compel all the companies in this city to run their wires underground.

WATER AND MUNICIPAL.

Sewerage.—*Holyoke.*—A sewer is to be built for the relief of the northwest sewer district; it will cost about $5,000. Mr. ELLSWORTH is City Engineer.

Flushing, N. Y.—A sewer of 12 and 15-in. pipe is to be laid by the Village Trustees. Col. G. A. ROULLIER is the engineer.

New Castle, Pa.—The city is constructing a sewerage system according to a plan furnished by Col. GEO. E. WARING, Jr. About 2¼ miles are completed and in operation and the work in the first district will probably be completed this year. J. H. MILLER is City Engineer.

Reading, Pa.—A report and general plan for a system of sewerage and sewage disposal has been made to the Common Council by C. Ph. BASSETT, C. E. The complete system, only a part of which would be built at first, would include 19.1 miles of storm sewers at an average cost of $25,000 per mile, and 99.1 miles of house sewers at an average cost of $4,425. It is proposed to convey the sewage to Independence Id., to be treated.

Salisbury, Md.—A company has been organized by E. E. JACKSON, J. CANNON, F. C. TODD, and others, to build sewers.

Charleston, W. Va.—An ordinance has been adopted providing for the issuing of bonds for sewers and street improvements.

Salisbury, N. C.—It is proposed to issue bonds for sewers and other public works.

Savannah, Ga.—Mr. RUDOLPH HERING, M. Am. Soc. C. E., is making investigations and will report upon the sewerage question.

Americus, Ga.—A vote will be taken March 13 on the proposition to issue bonds for $35,000 for a sewerage system.

Rome, Ga.—The Health Committee is considering propositions for the establishment of a sewerage system.

Greensboro, Ga.—It is proposed to issue bonds to pay for a sewerage system. For particulars address the mayor.

Morgan Park, Ill.—Arrangements have been made to flush the sewers from the water-works. As there is a drop of about 75 ft. from the beginning of the sewer to the point where it empties into the Calumet river, a distance of about 3 miles, this can readily be done.

Fort Worth, Tex.—The city is putting in about 8 miles of sewers.

Houston, Tex.—It is proposed to organize a company to build sewers; capital stock, $100,000. ROBERT MORRIS is interested.

Corsicana, Tex.—A sewerage system is to be built this spring, and plans and specifications are being prepared. For particulars address CHAS. H. ALLY, Mayor.

Walla Walla, Wash. Ty.—In answer to a request from the city, Col. GEO. E. WARING, Jr., has estimated the cost of a sewerage system at $150,000. Mr. KELLING is City Clerk.

Chehalis, Wash. Ty.—A sewerage system is contemplated. H. A. RAY, of the water company, is interested.

Brockville, Ont.—The Sewer Commissioners have presented their report for 1888, with which is the report of Mr. WILLIS CHIPMAN, the engineer. The system adopted is the modified separate system. The sewer pipe is from Scotland and from St. John's, Que. Brockville bricks are used. The sewers were first ready for use in November, 1888. Extensions are recommended to be carried out during the summer.

Newark, Del.—The new water-works were opened Feb. 22. The supply is taken from springs which feed a well 35 ft. deep and 25 ft. diameter; the capacity of the supply is 10,000 galls. per hour. The water is pumped to a stand-pipe by two Holly engines of 500,000 galls. daily capacity each; steam is furnished by two steel tubular boilers of 60 H. P. each. The mains are 6 and 10 ins. diameter, and there are 35 double-nozzle fire hydrants. The stand-pipe is 50 ft. high and 25 ft. diameter, with a capacity of 186,000 galls; pressure from the pipe will throw a fire stream 75 ft. high, and by direct pumping a height of 175 ft. can be reached. The stand-pipe was built by Basshore & Co., of Baltimore, Md.; the hydrants by the Union Hydraulic Co.; and the pipes and specials by McNeal & Co., of Burlington, N. J. The Baltimore & Ohio R. R. Co. pays $60 per month for water for 10 engines per day. The works have cost about $30,000 and extensions and improvements are already contemplated. The well was dug and the pipe-laying done by Joseph Hyde, of Wilmington. ISAAC S. CASSIN, of Philadelphia Pa., was the engineer.

Natchez, Miss.—The following proposals for the construction of a complete system of water-works were opened Feb. 21 by A. L. HOWE, Chairman of the Committee on Gas and Water: Moffett, Hodgkins & Clarke, Watertown, N. Y.; rental plan, $5,400 for 90 hydrants or $5,700 for 110 hydrants; additional hydrants, $45 each, not less than 11 to the mile; to construct works for the city, $120,000.——R. E. H. Smith, Helena, Mont.; to construct works for the city, $120,000.——Ira C. Terry & Co., St. Louis Mo.: rental plan, 90 hydrants, 11 to the mile, $60 each; additional hydrants, $50 each; to construct works for the city, $138,000.——J. A. Jones, St. Louis, Mo.; rental plan, $5,500 for 90 hydrants or $5,000 for 100 hydrants. The contract was awarded to J. A. Jones for 100 hydrants at $5,000 per year. He has the right to buy the works at the end of every term of ten years. The contractor to furnish water free to all public buildings and four fountains, and also put an ornamental fountain in Memorial Park not to cost less than $1,500. Work will be commenced shortly and completed in 6 months, although the contract gives him 12 months. The city will put in a complete system of sewerage in connection with the water-works at no cost to the city, depending upon the citizens to take water.

Water-Works.—*Maine.* Sullivan. The Sullivan Harbor Land Co. has obtained a charter allowing it to take water from Long Pond, and will put in water-works in the spring. The lake is 350 ft. above the sea, and 2¼ miles from the company's property.

New Hampshire.—Milford. The Milford Water-Works Co. has organized as follows: President, ROBERT BLACKIE; Treasurer, JOHN T. LANGFORD; Directors, ROBERT BLACKIE, J. S. BLACKIE, S. L. POWERS, J. A. WALKER, and J. T. LANGFORD.

Connecticut.—Windsor Locks. A special town meeting was held Feb. 27 to consider whether the new water company should be exempted from taxation.

New York.—Saratoga Springs. The village trustees have decided to renew the water bonds, representing $158,000, when they become due on Sept. 1.——Glens Falls. Water Commissioner EUGENE ALLEN has presented his annual report to the Board of Trustees. The old cement mains are in good condition. There have been 21 breaks since April 15, 1888. He has laid 4,016 ft. of new 6-in. cast-iron pipe and 3,084 ft. of 4-in. He had on hand at the beginning of the year $519.22, has received since then $16,602.30, paid out $16,009.48, and has a balance of $1,112.13. There are uncollected water rents to the amount of $65.49.

New Jersey.—Bayonne. A proposition has been made to the City Council, by WILLIAM RUMBLE, C. E. to furnish a plant and water supply for $600,000, in 5 per cent. city bonds. He offers to furnish 3,000,000 galls. of water a day from the Rockaway river or its tributaries. The works to consist of a storage reservoir having a capacity of 300,000,000 galls., an intermediate or secondary reservoir having a capacity of 10,000,000 galls., and a conduit pipe of cast-iron of not less than 16 ins. diameter reaching from the storage reservoir to Avenue C in the city of Bayonne, with all the necessary valves and appurtenances for operating and controlling the water.

Pennsylvania.—Greensburg. There has been some trouble with the supply from the Westmoreland water Co., owing to broken mains and imperfect connections. ——Johnstown. The Johnstown Water Co. has contracted for a 36-in. main from the Shade creek or the Stony creek. Work will be commenced at once and will be finished this fall, and when completed there will be 50 miles of pipe in use from the several reservoirs. ——Rochester. The proposition of a company which was organized some months ago to furnish a water supply has been rejected.——Wilkinsburg. A company has been formed with $100,000 capital stock, and the contract let to the Pittsburg Water Co. to furnish a water supply. The Pittsburg Co. agrees to lay 16 miles of pipe altogether, 6 miles to be in the streets of the town. The reservoir will be located on the hill near Wildwood on the Allegheny Valley Ry. about 2 miles above the Brilliant station reservoir. Work is to be commenced on the 1st of March. The borough proper contracts for 25 fire-plugs, for which $50 a year will be paid. If the plugs stand a test and show a pressure that will send a stream to the height of the buildings in the town, the lease will be extended to ten years. Private consumers are to be supplied at rates that will not exceed those paid by the city of Pittsburg. Already 70 car loads of pipe, assorted sizes, have been ordered. The works will be built under the supervision of JAMES H. HARLOW, hydraulic engineer.

Georgia.—Savannah. An additional water supply and plant are needed. For particulars address the mayor.

Mississippi.—Vicksburg. The water-works, when completed, will have a capacity of 600,000 galls. The reservoir is 800 ft. long and 100 ft. wide.

Louisiana.—The New Orleans Water-Works Co. is making investigations with a view to putting in a filter plant.

Tennessee.—Chattanooga. The committee appointed to report as to the city building and owning its own water-works has recommended that the authority to issue bonds to build said works be secured. For particulars address the mayor.

Kentucky.—Catlettsburg. Address the mayor for particulars in regard to the projected water-works.——Paris. The water-works question is again being agitated.——Hopkinsville. M. C. FORBES can give particulars in regard to the proposed water-works. Surveys and estimates are to be made at once.

Indiana.—Terre Haute. An offer of $250,000 has been made by Mr. JAMES GAMBLE, of New York, for the water-works. This offer has been declined, but Mr. GAMBLE has the option of purchasing the works for a somewhat higher price.

Michigan.—Owosso. Work is progressing rapidly on the pumping station. The ninth well has struck water.——Alpena. There are now nearly 17¼ miles of pipe, mostly wooden. The number of fire hydrants is 142, of which 10 are paid for by the mills. The annual water rent of the city for fire purposes is $8,580. The present contract between the city and water company is claimed to be void on account of non-compliance with the terms of the contract, and a bill is now before the Legislature to legalize the old contract, or to allow another to be made. The proposed act gives the Common Council the power to make a new contract. The agreement of the water company was to furnish as good water for domestic purposes as Thunder Bay affords. From the opening of the works in 1879, until Dec. 12, 1888, the water furnished was from the river. Since Dec. 12, water has been furnished from the bay near Avery's lumber mill. At present the water furnished is first-class, but what it will be in the summer time cannot be told now. It is believed that the end of the inlet pipe is too near the shore, being only 1,500 ft. from the beach.

Illinois.—South Chicago. Superintendent POWELL, of the Public Works Department, is preparing plans for a 4-ft. water tunnel under the Calumet river, at 95th St. East South Chicago will thereby be assured of an abundant supply of Lake Michigan water.

Wisconsin.—Appleton. The city has connected its water-pumping station with the Fox river, in order to secure a supply of water for fire purposes in case the wells prove insufficient to meet the demands.

Minnesota.—Winona. The committee on water-works reported that they had revised the plans and estimates for water mains and reduced the necessary purchase of mains from 425 tons to 301 tons. The total cost of this amount of pipe with specials, hydrants, and cost of laying will not exceed $14,000. With the estimates for the water-works department for next year there is available for this purpose $14,000. The committee therefore recommended the acceptance of the bid of Shickle, Harrison & Howard, of St. Louis, for pipe at $22 per ton and specials at $48 per ton. A resolution was adopted to purchase hydrants of the Galvin Brass & Iron Works, including 12 hydrants with hose cut-off at $33 each.

Texas.—Temple. The water company wants to purchase pumping machinery and 1,000 tons of pipe.——Cleburne. Mr. MORGAN JONES, of Fort Worth, proposes to build water-works.

Oregon.—Portland. The water committee's bill to issue $1,500,000 bonds to increase the water-works has been killed by the Governor.

Wyoming.—Fort D. A. Russell. Congress has been asked to appropriate $34,500 for the completion of the water supply system